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BROWNFIELD PRELIMINARY ASSESSMENT II

GEORGE GRAY ELEMENTARY SCHOOL
WILMINGTON, DELAWARE

DELAWARE DEPARTMENT OF NATURAL RESOURCES AND
ENVIRONMENTAL CONTROL



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EXECUTIVE SUMMARY

The Delaware Department of Natural Resources and Environmental Control (DNREC) Site Investigation and Restoration Branch (SIRB), in cooperation with the United States Environmental Protection Agency (EPA), conducted a Brownfield Preliminary Assessment II (BPA II) for the former George Gray Elementary School site located at 2113 Thatcher Street in Wilmington, Delaware.

The property is located in the northeast section of Wilmington. Vandever Avenue borders the property on the southwest, Locust Street on the northwest, 23rd Street on the northeast and Thatcher Street on the southeast. The site consists of approximately 4.0 acres, and is located in the northeast section of the City of Wilmington. The coordinates of the site are 39° 44' 53" North, and 75° 31' 59" West (1987).

The property was formerly an elementary school that was constructed in approximately 1924. A building addition was added facing Locust Street in approximately 1954.

The primary proposed reuse of the building is a Charter School. This adaptive reuse of the building would include the additions of a culinary arts school and possible catering business, a community banquet and conference center and two cafes. Also proposed are a day care center and a recording studio.

The purpose of the Brownfield Preliminary Assessment II was to investigate the possible existence of released hazardous substances at the George Gray School site through the collection and analysis of environmental samples. The media sampled included surface soils and deep soils. Soil samples were field screened by the DNREC SIRB Analytical Chemist and selected samples were submitted to the DNREC Division of Water Resources Environmental Services Laboratory for analysis of specified parameters.

The analytical data generated from the collection and laboratory analysis of the environmental samples was subsequently evaluated to determine the potential for human and environmental exposures to hazardous substances.

After the completion of the BPA II, DNREC submitted the report to the EPA and State officials who will decide whether the site should undergo further investigation or obtain a "No Further Action" (NFA) designation under the Federal Superfund and/or State Site Investigation & Restoration Branch Programs.

The BPA II is intended to provide a general characterization of the environmental conditions present at the site and does not provide a 100% complete surface and subsurface assessment of the project area or individual properties. The assessments contained within are based solely on conditions at the time of sampling and the specific locations evaluated.

As part of the BPA II, 11 test pits were excavated and 11 shallow and 14 deep soil samples were

collected. Five additional shallow soil samples were collected from areas close to the building.

Test pit logs indicate that the site has received fill materials including sands, silts, clays, gravels, rock and bricks, with some wood, metal, slags, coal, and coal and incinerator ash. Some trash and miscellaneous debris were also noted. Depths of fill materials encountered ranged from 2 to 13 feet.

The property is mostly unfenced and access is unrestricted on the majority of the property. The south parking area is paved and fenced and most of the remaining property is grass covered.

Soil samples were collected from 11 test pits locations throughout the site area. Soil samples were field screened for PCBs and PAHs and related pesticides using immunoassay test kits and for metals using XRF.

Based on the results of field screening, soil samples from the George Gray School property exhibited elevated concentrations of some metals, most notably Arsenic and Lead. Arsenic and Lead were both detected in shallow and deep test pit soil samples in excess of screening benchmarks.

Elevated Arsenic and Lead concentrations were confirmed by laboratory analysis of selected samples. Five out of six soil samples submitted to the laboratory exhibited Arsenic concentrations greater than screening benchmarks, with a high of 40.8 mg/Kg. Five out of six soil samples submitted to the laboratory contained Lead at concentrations above the benchmark for residential soil (URS) and two of these exceeded the Industrial soil URS. The highest concentration of Lead detected was 1510 mg/Kg. The highest Lead concentrations were detected in test pits TP-4 and TP-9 and were associated with coal or incinerator ash found in the test pits.

Iron, Manganese and Zinc were also detected in soil samples at concentrations greater than the residential URS and/or RBC's.

Two samples were submitted for TCLP metals analysis. TCLP analysis indicates that both samples were below the regulatory level for Lead as a hazardous waste. The other metals were also below the applicable levels.

Immunoassay screening and subsequent laboratory analysis of soil samples indicated no significant concentrations of PCBs to be present in the site samples.

Carcinogenic PAHs were the primary organic contaminant of concern with six out of seven samples submitted for laboratory analysis significantly exceeding the screening benchmark. The highest total PAH concentration was over 120 ppm in sample TP-3S. Sample SS-4 also exhibited significantly elevated total PAH values.

In addition to the laboratory data presented in the tables and analytical data package, the data validator also reported that the chromatograms for soil samples TP-3S, TP-10D, TP-6S and SS-4 exhibited coal ash/tar C11-C22 aromatic petroleum patterns. The results exceed HSCA guidance

criteria in TP-3S.

A review of the George Gray School property was also undertaken by representatives from the DNREC Underground Storage Tank Branch (UST) and Air Resources Branch in order to evaluate the presence or absence of underground storage tanks or asbestos. In addition, USA Environmental Management Inc. (USAEMI) performed a hazardous materials evaluation of the building structure. Along with the issues related to testing of environmental media, these assessments have resulted in the following recommendations:

- Two Underground Storage Tanks (USTs), formerly containing heating oil are located in the southeastern corner of the property in the parking lot. The tank sizes are listed as 8000 and 10,000 gallon. The UST Branch has determined that these tanks must be removed or properly abandoned and the surrounding soil sampled for contamination. No surface evidence of other USTs was noted, however the presence of other tanks couldn't be completely ruled out.
- Asbestos Containing Material (ACM) in the form of thermal insulation, floor tiles and debris was noted on the inside of the building. Some possible ACM may also be contained within the built-up roofing materials. DNREC-SIRB advises that prior to any demolition an asbestos survey via a **State of Delaware Certified Professional Firm** must be performed to identify any other possible asbestos containing materials.
- Several damaged paint surfaces were tested by USAEMI for the presence of Lead. All but two samples tested contained Lead in excess of the level established by EPA as "positive". Stabilization or abatement of Lead-containing paint in the building should occur to reduce potential hazards.
- The presence of several drums of unknown material was noted in the USAEMI report. The contents of these drums should be tested to characterize the material and then the drums should be disposed of in accordance with applicable regulations.
- The building contains fluorescent light fixtures that were noted in the USAEMI report. PCB containing oils were present in the ballasts associated with these light fixtures. The fluorescent tubes and PCB containing ballasts should be removed and properly disposed of in accordance with applicable regulations.

Based upon the information collected from the Brownfield Preliminary Assessment II at the former George Gray Elementary School, the DNREC SIRB identified the following issues and concerns, which need to be addressed with oversight by DNREC:

- Based upon the contaminants detected in the on-site soils, there is potential exposure of people to contaminated soil through inadvertent ingestion and airborne dust, primarily during excavation,
- Potential exposure of workers to contaminated soils during excavation and construction

especially in the area containing Lead and PAH concentrations,

- Two heating oil USTs are out of compliance and must be removed and the surrounding soil sampled and analyzed,
- Remediation and proper disposal of the asbestos containing materials and lead containing paint should be completed,
- Removal and proper disposal of fluorescent tubes and PCB containing oil and ballasts should be completed.

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1.0 INTRODUCTION

The Delaware Department of Natural Resources and Environmental Control (DNREC), Site Investigation and Restoration Branch (SIRB), in cooperation with the United States Environmental Protection Agency (EPA), conducted a Brownfield Preliminary Assessment II (BPA II) at the former George Gray Elementary School site. (Figures 1, 2, 3, 4)

The purpose of the Brownfield Preliminary Assessment II was to investigate the possible existence of released hazardous substances at the portion of the site through the collection and analysis of environmental samples. The analytical data generated from the collection and laboratory analysis of the environmental samples was subsequently evaluated to determine the potential for human and environmental exposures to hazardous substances. After the completion of the BPA II, DNREC will submit a report to the EPA and State officials who will decide whether the site should undergo further investigation or obtain a “No Further Action” (NFA) designation under the Federal Superfund and/or State Site Investigation & Restoration Branch Programs.

This study is intended to provide a general characterization of the environmental conditions present at the site and does not provide a 100% complete surface and subsurface assessment of the project area or individual properties. The assessments contained within are based solely on conditions at the time of sampling and the specific locations evaluated, and must be viewed in that context.

2.0 SITE DESCRIPTION AND OPERATIONAL HISTORY

2.1 Site Description

The site is approximately 4.0 acres in size and encompasses the majority of the block bounded by Vandever Avenue, Locust Street, 23rd Street and Thatcher Street. A row of homes is located along the Vandever Avenue side of the property. A large “L”-shaped multi-story brick building (a former elementary school) is located near the center of the property. A large asphalt paved parking lot, surrounded by a locked gate and fence, is located on the southwest side of the building. The parking lot is cracked and broken with weeds and grass growing through the cracks. A large grassed field is located on the northeast side of the building property. A small open paved area, the former playground, is at the north end of the building. The coordinates of the site are 39° 44’ 53” North, and 75° 31’ 59” West (1987).

The property was formerly an elementary school that was constructed in approximately 1924. A building addition was added facing Locust Street in approximately 1954.

The building is currently undergoing asbestos and lead paint abatement on the inside of the structure. An office trailer is located in the south parking lot and a storage trailer is on the northwest side of the building.

A review of Underground Storage Tank (UST) Branch files indicates that there are two underground storage tanks present on the property. According to the property owner's consultant, the tanks are located at the southeast end of the parking lot. UST Branch tanks records indicate that they consist of one 10,000 gallon and one 8,000 gallon steel heating oil tanks installed in 1926. According to UST representatives, the tanks must be removed, but no activity has taken place at this time. Parks and open space are located on adjacent parcels on both the north and south sides of the school property. Private homes and apartments, and a small church border the remainder of the site.

The George Gray property is bounded to the north and east by the Eastlake housing project, to the west and south by private homes, to the south east by a baseball field and park and to the northwest corner by Price's Run Park.

DNREC - Property Owner Site Visits – George Gray School Property

On October 9, 1998, DNREC-SIRB staff toured the outside of the property with a representative of USA Environmental Management, Inc. (USAEMI), the oversight consultant for the property owner. Several representatives of Phase V Community Development Corporation, the property owner, then met with the SIRB Program Manager and Project Manager to discuss the project.

The primary proposed reuse of the building is a Charter School. This adaptive reuse of the building would include the additions of a culinary arts school and possible catering business, a community banquet and conference center and two cafes. Also proposed are a day care center and a recording studio.

Historical Map Review

Review of historical maps indicates that the George Gray School property was part of the William Thatcher estate in 1876 (G. M. Hopkins), 1893 (G. Wm. Baist) and 1901 (Baist). All three maps indicate that the property was primarily open land with little development. Paper streets are shown on all three maps. The 1876 maps show a small stream across the northeast corner of the property (Figure 5).

In the 1893 map, the stream, which crosses the property and continues to the northwest, is identified as Price's Run. The surrounding properties are mostly vacant with a few small structures such as farms. An icehouse is located three blocks east and a cotton mill is located six blocks west along Vandever Avenue (Figure 6).

By 1901, a row of homes is present along Vandever Avenue between Thatcher and Locust Streets. The remainder of the property is vacant. These homes are still present today along the southwest boundry of the school property (Figures 7, 8).

The 1906 topographic map indicates that the school property is still vacant with no significant structures or roadways present (Figure 9). The 1936 topographic map shows the original wing of the school to be present. A pond is located on Price's Run in parkland to the north of the school (Figure 10).

3.0 PREVIOUS INVESTIGATIONS

George Gray School Property – 2113 Thatcher Street

The following site description for the George Gray School is derived from excerpts from the Hazardous Material Summary/Cost Proposal for the George Gray School by USA Environmental Management, Inc., January 7, 1997.

A limited investigation was conducted at the site in December 1996 to develop a list of hazardous materials present in the building that would need to be addressed prior to renovation. Items noted in the report found inside the building included Fluorescent light tubes, Fluorescent light ballasts containing Polychlorinated Biphenyls (PCBs), several drums containing unknown materials, insulation, floor tiles, debris and soil containing Asbestos, and Lead-based paint and debris. In addition, two underground fuel oil storage tanks were located on the southeast portion of the property. The report also notes that vandalism and looting have been a problem at the site and that much of the damage to the asbestos containing materials (ACM) has resulted from these activities.

Recommendations presented in the report included the removal and abatement of all accessible asbestos in the building and decontamination of all exposed surfaces, removal or stabilization of lead-based paint, removal and proper disposal of fluorescent light tubes and ballasts, characterization and disposal of drummed material. The report also recommended the removal and remediation of the underground storage tanks, supply lines and piping and any contaminated soil.

Some asbestos abatement has already been started, but is currently on hold pending funding of the project.

Deed Search

<u>Deed Book and Page</u>	<u>Seller</u>	<u>Purchaser</u>	<u>Transaction Date</u>
bk2245 pg177	City of Wilmington	Phase V of Delaware	February 28, 1997
bk2245 pg175	Brandywine School District	City of Wilmington	February 28, 1997
H115 pg142	New Castle County School District	Brandywine School District	June 24, 1981
	Deed record ends		

4.0 ENVIRONMENTAL SAMPLING

4.1. *Introduction*

Sampling of environmental media was performed at the George Gray School property site in order to identify and characterize the presence of contaminants that may have been released due to historic and current activities. Test pit excavation and soil sample collection took place on December 1 and 2, 1998.

DNREC collected 30 media samples during the BPA II, plus quality assurance/quality control (QA/QC) samples. Of this total, 12 media samples (plus QA/QC samples) were submitted to the DNREC-Division of Water Resources Environmental Services Laboratory for confirmatory analysis of chemicals of concern.

Chemicals of concern consisted of all or part of the USEPA Target Analyte List (Inorganics) and Target Compound List (Organics) (TAL/TCL) (Appendix A). Partial and/or full TAL/TCL analysis was conducted on samples based upon the results of the mobile-lab field screening. Field screened samples identified as having elevated concentrations of contaminants for a particular chemical suite were sent to the DNREC Division of Water Resources Laboratory for confirmatory analysis. Analysis included volatile and semivolatile compounds, Pesticide/PCB, metals and Toxic Characteristic Leaching Procedures (TCLP) for metals.

Soil samples delivered to the DNREC laboratory were screened in the SIRB mobile laboratory for the following classes of compounds: Volatile Organics, Pesticides, Carcinogenic PAHs, PCBs, and Metals. Screening was performed in the mobile lab using Immunoassay Test Kits, Gas Chromatography/Mass Spectroscopy (GC/MS) and an X-Ray Fluorescence instrument (XRF). Information regarding the field screening procedures is shown in Appendix B.

In the fixed lab, the GC/MS System was used to analyze soil and water samples for Volatile and Semi-Volatile Organic Compounds (VOCs/SVOCs), Pesticides and PCBs. Metals were tested using an Atomic Absorption Unit and an Inductively Coupled Plasma Unit (AA and ICP). These constituents are analyzed at sites with environmental and health impact concerns because they are commonly found in former industrial and landfilled areas. The above constituent groups comprise the EPA TAL/TCL list. Analysis using the GC/MS system and AA and ICP provides a good cursory tool in which to determine the presence or absence of compounds and analytes at sites under investigation.

DNREC sampled both the shallow and deep soil media in the area of investigation. Shallow and deep soil samples were generally collected from 0 to 2 feet and below 2 feet respectively. Deep soil samples were collected using a backhoe from test pits excavated to a maximum depth of 17' or until groundwater was reached. Test pits were used to evaluate subsurface conditions such as natural soil strata or composition of fill. Shallow and deep soil samples were taken from each test pit. The test pits were subsequently refilled and leveled using the excavated materials. The DNREC-SIRB Scientists prepared descriptive logs of the test pits that are presented in

Appendix C.

4.2. Sampling Locations

Figure 16 shows the sampling locations for the George Gray Elementary School investigation.

Sampling of environmental media was accomplished through the collection of 30 soil samples, plus Quality Assurance/Quality Control (QA/QC) samples. Sample descriptions and locations are listed in Table A.

Table A. Sample Locations and Descriptions for Test Pits and Soils

SAMPLE ID	LOCATION	SAMPLE DESCRIPTION
SHALLOW SOIL SAMPLES		
GGSS-1	N. of main entrance near Thatcher St., near 1924 stone	0-12"
GGSS-2	Inside corner of building structure	0-18"
GGSS-3	E. of new wing, 5' W. of sidewalk	0-5"
GGSS-4	N. end of bldg., along Locust St.	0-6"
GGSS-5	S. end of bldg., along Locust St.	0-5"
SHALLOW TEST PIT SAMPLES		
GGTP-1	W. end of south asphalt parking lot, 40' off bldg.	TEST PIT, 12"
GGTP-2	Center of south parking lot	TEST PIT, 12'
GGTP-3	W. side of UST tank area, E. end of south parking lot	TEST PIT, 12-18"
GGTP-4	S. side of UST tank area	TEST PIT, 12-18"
GGTP-5	E. side of UST tank area	TEST PIT, 12"
GGTP-6	10' E. of old playground, N. end of new wing	TEST PIT, 12-18"
GGTP-7	Grassed field, N. end, E. of end of new wing	TEST PIT, 12-18"
GGTP-8	Grassed field, W. side, along sidewalk, E. of new wing	TEST PIT, 2'
GGTP-9	NE corner of grassed area	TEST PIT, 12-18"
GGTP-10	E. side of grassed area, 50' off Thatcher St. at 22 nd St.	TEST PIT, 12"
GGTP-11	N. side of bldg., grassed yard, N. of sidewalk, E. door	TEST PIT, 12"

DEEP TEST PIT SAMPLES		
TEST-1	W. end of south asphalt parking lot, 40' off bldg.	TEST PIT, 12-13'
TEST-2	Center of south parking lot	TEST PIT, 10'
TEST-3	W. side of UST tank area, E. end of south parking lot	TEST PIT, 12'
TEST-4	S. side of UST tank area	TEST PIT, 12-13'
TEST-5	S. side of UST tank area	TEST PIT, 3'
TEST-6	E. side of UST tank area	TEST PIT, 11'
TEST-7	10' E. of old playground, N. end of new wing	TEST PIT, 11-12'
TEST-8	Grassed field, N. end, E. of end of new wing	TEST PIT, 10-11'
TEST-9	Grassed field, W. side, along sidewalk, E. of new wing	TEST PIT, 11-12'
TEST-10	NE corner of grassed area	TEST PIT, 11'
TEST-11	E. side of grassed area, 50' off Thatcher St. at 22 nd St.	TEST PIT, 11'
TEST-12	N. side of bldg., grassed yard, N. of sidewalk, E. door	TEST PIT, 10-11'
TEST-13	S. side of UST tank area	TEST PIT, 3'
TEST-14	NE corner of grassed area	TEST PIT, 11'

WATER SAMPLES		
TEST-15	Trip Blank	WATER, QA/QC
TEST-16	Equipment Rinsate Blank	WATER, QA/QC

Based on field screening results, specific samples were selected for analysis by the DNREC Environmental Services Laboratory. Samples submitted to a fixed laboratory (exclusive of QA/QC samples) for all or part of the EPA TAL/TCL analytical package included:

- 7 shallow test pit soil samples;
- 5 deep test pit soil samples;

The specific parameters that were requested for laboratory analysis for soils and sediment are indicated below (Table B).

Table B. Samples Submitted for Laboratory Analysis
George Gray Elementary School

Sample ID	VOC	SVOC	Pest/PCBs	Metals/Cyanide	TCLP	Summary
SOIL SAMPLES						
	X	X	X	X		
		X				
				X		
				X	X	
		X				
		X				
		X				
				X	X	
TP-2B		X				MS/MSD
TP-4C				X		Dupl. TP-4C
TP-9D				X		Dupl. TP-9D
TP-10		X				
WATER SAMPLES						
	X					Trip Blank
	X	X	X	X		Rinse Blank

VOCs – Target Compound List Volatile Organic Compounds

SVOC – Target Compound List Semivolatile Organic Compounds

Pest/PCBs – Target Compound List Pesticides/Polychlorinated Biphenyls

Metals/Cyan - Target Analyte List Inorganics and Cyanide

TCLP – Toxic Characteristic Leaching Procedure Metals-As, Ba, Cd, Cr, Pb, Hg, Se, Ag

Samples Submitted to DNREC Environmental Services Laboratory, Dover, Delaware

4.3. Analytical Analysis

The results received from the laboratory analysis were compared to the following criteria: EPA Region III Risked-Based Concentration Tables (RBCs) and DNREC Uniform Risk-Based Standards (URS).

Deep and surface soil sampling analytical results were compared to the following criteria: the RBCs for industrial and residential soils and to the URS.

5.0 GROUNDWATER PATHWAY

5.1. Hydrogeologic Setting

The George Gray School property is located within the Piedmont Physiographic Province lying just

The basement rock beneath the site is part of the metamorphic and igneous derived Wilmington Complex. Meta-igneous rocks formed mainly of andesine, hypersthene, clinopyroxene and magnetite with minor amphibole underlie the majority of the site. The southwest corner may be composed mainly of hypersthene-quartz-andesine-gneiss with minor biotite and magnetite. (Figure 12) The thickness of the regolith at the site may vary from 0 to 50 feet. (Figure 13).

The water table aquifer in the Piedmont generally forms at the base of the regolith, directly above the unweathered bedrock. The depth to groundwater varies depending on the depth of the weathering and may be locally shallow. The Wilmington Complex stores and transmits groundwater almost entirely within fractures and generally in small quantities. Groundwater yields from the hard rock of the Wilmington Complex are generally low, with the yield of the average home well approximately 1 gallon per minute.

From the Fall Line south, the crystalline basement rock is overlain by the Potomac Formation, consisting of variegated clays and silts with some interbedded sands. These sands are generally thin and irregular in the northern part of the Coastal Plain. The Potomac Formation thickens to the southeast but is expected to be generally thin immediately south of the project area. The Potomac Formation is used extensively for water supply to the south of the project area where the sand layers are sufficiently thick (Figure 12).

The study area is expected to have little potential for significant groundwater supply development as a result of low yields due to low transmissivity of the aquifers and little available drawdown.

Local groundwater flow at the site is expected to be south and west towards the Brandywine Creek.

5.2. Groundwater Targets

The George Gray School property is contained entirely within the City of Wilmington's corporate boundaries. The City of Wilmington Water Department provides the potable water supply. The city utilizes surface water from Brandywine Creek for its primary water supply.

The City's closest intake is on the Brandywine Creek at a dam in Brandywine Park, 2.5 miles upstream from the confluence of the Brandywine Creek and Christina River. Water is drawn from the Brandywine Creek via a raceway with headwaters approximately 1.2 miles west-northwest of the school property. The city supplies water to approximately 140,000 individuals in the Wilmington metropolitan area and has water system interconnections with other area suppliers.

The nearest public water supply well is located at Collins Park approximately four miles to the south of the site. The Collins Park well is part of the Artesian Water Company ("AWC") supply system. The Collins Park Well serves approximately 3308 AWC customers. AWC utilizes a blended water system of over 40 wells and 12 interconnections with the Cities of Wilmington, Newark and New Castle, United Water Delaware, and the Chester (PA) Water Authority to serve

its 171,800 customers.

The remaining public water supply wells belonging to AWC, are located more than 4 miles south of the site.

The Water Supply Branch of DNREC conducted a DWUDS (Delaware Water Use Data System) search for drinking water wells located within four miles of the site.

The nearest drinking water well is over one mile to the southeast of the site. Three domestic drinking water wells were found within 1 to 2 miles of the site, one well was between 2 to 3 miles, and twenty-five wells were between 3 and 4 miles. Assuming an average of 3 persons per household, a total of 87 people are served by domestic wells within a four-mile radius of the site. This number can be expected to be higher due to wells constructed prior to 1970 when the well permitting program was initiated.

The nearest Wellhead Protection Area, as defined by New Castle County ordinance is approximately 4.0 miles to the south and east.

5.3. Groundwater Sample Locations

No groundwater samples were collected during this phase of the investigation. Historical review of the property indicates no significant sources of contamination other than filling of low lands. In addition, there are no known groundwater targets in the area.

In the event that significant soil contamination is detected at the site, SIRB may elect to collect groundwater samples from monitor wells or Geoprobe points during a later investigative phase.

5.4. Groundwater Conclusions

The groundwater at the George Gray School site is not used for domestic or public water supply. Generally, the groundwater flow direction is inferred to be toward the south and west, towards the Brandywine Creek. However, several large (6 to 9 foot diameter) combined sewer lines are present on or near the property and may affect groundwater flow direction.

The groundwater table at the George Gray property is highly variable. Groundwater was encountered in just 5 of the 11 test pits excavated on site, on top of the original marsh and streambed deposit.

6.0 SURFACE WATER PATHWAY

6.1. *Hydrologic Setting*

There is no surface water on or directly bordering the site.

The Brandywine Creek is located approximately 900 feet west of the subject property. Surface water coming from the site is expected to flow into the Brandywine Creek through overland flow, or into a combined sanitary and storm sewer system operated by the City of Wilmington. During major storm events, excess water may discharge to the river from Combined Sewer Overflows (CSO) located along the Brandywine Creek, just north of Northeast Boulevard.

The Brandywine Creek's mean annual discharge is 496 cubic feet per second (cfs). The Christina River's mean annual discharge is estimated at approximately 678.6 (cfs). The Brandywine flows approximately 1.5 miles to the confluence with the Christina River and the Christina joins the Delaware River approximately 1.5 miles downstream. Both streams are tidal at the point nearest the school property. The mean annual flow for the Delaware River, gauged at Trenton, New Jersey, is 11,744 cfs. The Delaware River is the surface water pathway for the remaining target distance.

According to the National Flood Insurance Rate Maps (1996), the site is approximately 20 feet above mean sea level and is located mostly within the special flood hazard areas inundated by the 100 year flood (Zone AE) along Price's Run (Figure 11). Price's Run is apparently culverted beneath the site.

The 1992 Delaware Water Quality Inventory (305b) Report Basin Assessment for the Christina River notes that several types of pollutants were found in the River. The Christina River and its tributaries have been found to have elevated concentrations of bacteria, toxic pollutants and heavy metals.

Contamination to the Christina River is derived from point sources and nonpoint sources. Surface water intakes for drinking water purposes are located on tributaries of the Christina River, including the Brandywine Creek upstream from the school area, however no public water intakes are located downstream of the site. The Christina River is a major tributary of the Delaware River and would contribute to its degradation.

6.2. *Surface Water Targets*

The Brandywine Creek is the site's closest surface water pathway, located approximately 900 feet west of the study area. In addition, the Christina River and Delaware River are direct targets of the site as a result of their relationship with the Brandywine.

In the Division of Fish and Wildlife's 1986-1991 Final Report, "Streams and Inland Bays Fish Survey," the tidal portions of the Brandywine and Christina Rivers were found to be used by

several non-resident species of fish for spawning and nursery habitat. Many resident species that use the Delaware River for spawning were found to reside in the tidal portions of the Christina River. The tidal portions of the Brandywine and Christina Rivers also support species with important commercial or recreational value, including catfish and several types of bass.

The Cherry Island Flats, located on the Delaware River adjacent to Edgemoor, are considered a primary spawning ground for the Striped Bass. Considerable recreational fishing occurs in the vicinity. The Delaware River also supports a sizeable commercial blue crab fishery.

Several wetlands are located along the Brandywine and Christina Rivers downstream of the Northeast Blvd. Bridge. (Figure 15)

The Delaware and Christina Rivers in addition to being designated fisheries are both used for extensively for recreation. For example, the Wilmington Rowing Club is located just north of the site on the Christina River.

6.3. *Surface Water and Sediment Sample Locations*

No surface water or sediment samples were collected from the Brandywine Creek located to the west of the George Gray site.

6.4. *Surface Water & Sediment Conclusions*

There is no surface water on or directly bordering the site.

The Brandywine Creek is located approximately 900 feet west of the subject property. Surface water coming from the site is expected to flow into the Brandywine Creek through overland flow, or into a combined sanitary and storm sewer system operated by the City of Wilmington. During major storm events, excess water may discharge to the river from Combined Sewer Overflows (CSO) located along the Brandywine Creek, just north of Northeast Blvd.

No surface water or sediment samples were collected during this investigation due to a lack of a direct surface water pathway.

7.0 SOIL EXPOSURE AND AIR PATHWAYS

7.1. *Physical Conditions*

According to the U. S. Department of Agriculture (USDA), Soil Conservation Service (SCS) soil mapping report, site soils consist of the Neshaminy-Talleyville-Urban Land complex. It consists of well-drained Neshaminy and Talleyville soils that are used for residential and other community developments. Much of this complex has been covered with fill or grading

materials, or has had much of the original soil profile removed. (Figure 14).

Test pit logs from the George Gray School investigation indicate that the subject site has received fill materials including sands, silts, clays, gravels, rock, bricks, wood, metal, coal and coal ash, incinerator ash, slags, concrete, and glass and other miscellaneous trash and debris. Depths of fill materials encountered ranged from 2 to 13 feet. (Appendix C)

Approximately 25,600 people live within one-mile of the site with the nearest residences located across the street and bordering the south parking area.

7.2. Soil Sampling Locations

A total of eleven (11) test pits were excavated on the George Gray school site. DNREC sampled both shallow and deep soil media in the area of the investigation. Eleven (11) shallow and fourteen (14) deep soil samples were collected using a backhoe from test pits excavated to a maximum of 17' or until groundwater is reached. Test pits were used to evaluate subsurface conditions of fill. Shallow and deep soil samples were taken from each test pit. The test pits were then subsequently backfilled and leveled using the excavated materials. In addition, five (5) shallow soil samples were collected from locations near the building. All soil samples were screened in the SIRB mobile laboratory.

Of the thirty (30) soil samples collected and field screened, ten (10) were selected for laboratory analysis. Specific parameters for analysis were requested for the samples as indicated in Table B.

Analytical results were compared to the RBC values for Industrial and Residential soil or to DNREC Uniform Risk-Based Remediation Standards where appropriate.

A map showing the soil sample locations is included in Figure 16. Test pit description logs are shown in Appendix C.

7.3. Soil Analytical Results – Inorganics

Field screening of all test pit and shallow soil samples for metals were completed using the XRF instrument. Of the samples screened, (including two (2) field duplicates), six (6) soil samples (one shallow and five deep) were submitted for laboratory analysis of inorganic parameters. Two (2) of these samples were also submitted for Toxic Characteristic Leaching Protocol (TCLP) analysis. The complete XRF data sheets are shown in Appendix G.

Soil Inorganic Results – Field Screening Data

Field screening using XRF indicated elevated metals concentrations in several samples. Based on XRF results, five samples contained Lead at a concentration greater than the residential

cleanup level. Other metals noted to be elevated in selected samples included Iron, Manganese and Zinc. Samples with elevated metals were generally associated with the presence of coal or incinerator ash. (Appendix G)

Soil Inorganic Results – Laboratory Data

As a result of the field screening, six (6) deep soil samples were submitted to the laboratory for inorganic analysis. The table below lists inorganic compounds exceeding Risk-Based Concentration benchmarks or DNREC Uniform Risk-Based Standards. Complete inorganic data tables are shown in Tables 1 and 2 (Appendix F). The data validation package is included in Appendix D.

Table C. Soil Samples Exceeding Benchmarks- Inorganic Laboratory Data

Soil Sample	Analyte	Concentration (mg/kg)	RBC Residential Soil (mg/kg)	RBC Industrial Soil (mg/kg)	URS (mg/kg)
TP-4S	Arsenic	8.5	0.43c	3.8c	2n/0.4c
	Lead	1510	400	1000	400
	Manganese	210			180
TP-2D	Iron	36400	23000		23000
	Manganese	439			180
TP-4C	Arsenic	10.2	0.43c	3.8c	2n/0.4c
	Lead	709	400		400
	Manganese	191			180
TP-9D	Arsenic	18	0.43c	3.8c	2n/0.4c
	Iron	44500	23000		23000
	Lead	546	400		400
	Manganese	607			180
TP-15 (dup. 4C)	Arsenic	12.3	0.43c	3.8c	2n/0.4c
	Lead	1450	400	1000	400
	Manganese	228			180
	Zinc	1010			1000
TP-16D	Arsenic	40.8	23n/0.43c	3.8c	2n/0.4c
	Iron	80800	23000		23000
	Lead	632	400		400
	Manganese	735			180
	Zinc	1510			1000

RBC – EPA Region III Risk-Based Concentrations, 4/12/99

URS – Remediation Standards Guidance under the Delaware Hazardous Substance Cleanup Act, 2/98

n-non-carcinogen c-carcinogen VI – as Chromium VI

In addition to the inorganic analysis performed by the DNREC laboratory, two soil samples were submitted for Toxic Characteristic Leaching Procedure (TCLP) analysis for metals. TCLP analysis tests the leaching potential of a material and determines if it classifies as a hazardous waste. Based on the results of the XRF field screening, samples were selected to include samples with higher concentrations of Lead, considered to be a contaminant of concern at the site. Sample TP-4C (2145 mg/Kg (XRF), 709 mg/Kg (Lab)) and TP-9D (920 mg/Kg (XRF), 546 mg/Kg (Lab)) were selected for TCLP analysis.

The results of TCLP analysis are shown in Table L, below:

Table D. Toxic Characteristic Leaching Procedure (TCLP) Results

Analyte	TP-4C mg/Kg	TP-9D mg/Kg	Regulatory Level mg/Kg
Arsenic	0.0296	0.0452	5.0
Barium	0.567	1.04	100.0
Cadmium	ND	ND	1.0
Chromium	ND	ND	5.0
Lead	1.59	3.07	5.0
Mercury	ND	ND	0.2
Selenium	0.007	0.0091	1.0
Silver	ND	ND	5.0

ND – Not Detected

BOLD – Sample Concentration Exceeds TCLP Regulatory Level

TCLP analysis indicates that both samples were below the regulatory level for Lead as a hazardous waste. The other metals were also below the applicable levels.

7.4. Soil Analytical Results – Organics

Soil Organic Results – Field Screening Data

Field screening for organic compounds utilized Gas Chromatography/Mass Spectroscopy (GC/MS) for volatile and semivolatile compounds, and Immunoassay test kits for polycyclic aromatic hydrocarbons (PAH) and polychlorinated biphenyls (PCB). GC/MS results indicated no volatile compounds in the soil samples collected at the site, however a number of samples contained significant concentrations of semivolatile compounds. These results were supported by the PAH immunoassay test kits which detected carcinogenic PAHs at estimated concentrations greater than 50 ppm in six samples. Immunoassay test kits for PCBs indicated no PCBs above the detection limit for the kits. (Appendix H)

Soil Organic Results – Laboratory Data

As a result of the field screening, seven (7) soil samples (five shallow and two deep) were submitted to the laboratory for all or part of the TCL organic analysis. Seven samples were analyzed for semivolatile organics, one was analyzed for pesticide/PCBs and one received volatile organic analysis. The table below lists organic compounds exceeding Risk-Based Concentration benchmarks or DNREC Uniform Risk-Based Standards. Complete inorganic data tables are shown in Tables 3 thru 11 (Appendix F). The data validation package is included in Appendix E.

Table E. Soil Samples Exceeding Benchmarks - Organic Laboratory Data

Soil Sample	Compound	Concentration (µg/kg)	RBC Soil		URS (µg/kg)
			Residential (µg/kg)	Industrial (µg/kg)	
SS-4	Benzo(a)anthracene	5500	875		900
	Benzo(b)fluoranthene	5400	875		900
	Benzo(a)pyrene	4900	87	784	90
	Indeno(1,2,3-cd)pyrene	3100	875		900
	Dibenz(a,h)anthracene	1500	88	784	90
TP-3S	Benzo(a)anthracene	14000	875	7840	900
	Benzo(b)fluoranthene	14000	875	7840	900
	Benzo(a)pyrene	11000	87	784	90
	Indeno(1,2,3-cd)pyrene	8900	875	7840	900
	Dibenz(a,h)anthracene	3400	87	784	90
TP-5S	Benzo(a)pyrene	550	87		90
	Dibenz(a,h)anthracene	160	87		90
TP-6S	Benzo(a)anthracene	1700	875		900
	Benzo(b)fluoranthene	2000	875		900
	Benzo(a)pyrene	1400	87	784	90
	Indeno(1,2,3-cd)pyrene	940	875		900
	Dibenz(a,h)anthracene	430	87		90
TP-9S	Benzo(a)anthracene	1200	875		900
	Benzo(b)fluoranthene	1400	875		900
	Benzo(a)pyrene	1100	87	784	90
	Dibenz(a,h)anthracene	310	87		90
TP-10D	Benzo(a)anthracene	2000	875		900
	Benzo(b)fluoranthene	1800	875		900
	Benzo(a)pyrene	1400	87	784	90
	Indeno(1,2,3-cd)pyrene	1200	875		900
	Dibenz(a,h)anthracene	450	87		90

RBC – EPA Region III Risk-Based Concentrations, 10/22/97

URS – Remediation Standards Guidance under the Delaware Hazardous Substance Cleanup Act, 2/98

7.5. Air Monitoring Results

A formal air sampling program was not conducted at the George Gray Elementary School site. Air monitoring was performed during sampling and drilling activities as part of the Health and Safety Plan utilizing a Foxboro TVA 1000 Dual Photo Ionization Detector/Flame Ionization Detector (PID/FID). No readings significantly above background were noted in the breathing zone during the investigation.

7.6. Soil Exposure and Air Pathway Conclusions

A review of area records and maps indicates that the property was primarily open land with little development until approximately 1926. Soil classification in the site area consists of well-drained Neshaminy and Talleyville soils that are used for residential and other community developments. Much of this complex has been covered with fill or grading materials, or has had much of the original soil profile removed. A streambed formerly crossed the property and is now either filled in or culverted beneath or around the property.

Observations made during test pitting activities indicated that the fill materials include sands, silts, clays, gravels, rock, bricks, wood, metal, coal and coal ash, incinerator ash, slags, concrete, and glass and other miscellaneous trash and debris. The fill materials were placed on top of the original streambed or marsh deposit, consisting of gray and dark gray silts and clays. In the southwest corner, the native material appears to have been red, orange and gray clays of the piedmont. Depths of fill materials encountered ranged from 2 to 13 feet.

Approximately 25,600 people live within one-mile of the site with the nearest residences located across the street and bordering the south parking area.

The property is mostly unfenced and access is unrestricted on the majority of the property. The south parking area is paved and fenced.

Soil samples were collected from 11 test pits locations throughout the site area. Sample locations were chosen on the basis of known historic land use activities and to provide a representative coverage across the property. Soil samples were field screened for PCBs and PAHs and related pesticides using immunoassay test kits and for metals using XRF.

Based on the results of field screening, soil samples from the George Gray School property exhibited elevated concentrations of some metals, most notably Arsenic and Lead. Arsenic and Lead were both detected in shallow and deep test pit soil samples in excess of screening benchmarks of 0.43 mg/Kg and 400 mg/Kg, respectively (Residential Risk-Based Concentrations and/or Uniform Risk-Based Standards). Test pit soil samples also contained Arsenic and Lead at concentrations greater than the screening levels for Industrial soils of 3.8 mg/Kg and 1000 mg/Kg, respectively.

Elevated Arsenic and Lead concentrations were confirmed by laboratory analysis of selected

samples. Five out of six soil samples submitted to the laboratory exhibited Arsenic concentrations greater than screening benchmarks, with a high of 40.8 mg/Kg Arsenic in sample TP-16D (the field duplicate of TP-9D). Five out of six soil samples submitted to the laboratory contained Lead at concentrations above the benchmark for residential soil (URS) and two of these exceeded the Industrial soil URS. The highest concentration of Lead detected was 1510 mg/Kg. The highest Lead concentrations were detected in test pits TP-4 and TP-9 and were associated with coal or incinerator ash found in the test pits.

Iron, Manganese and Zinc were also detected in soil samples at concentrations greater than the residential URS and/or RBC's.

Two samples were submitted for TCLP metals analysis. TCLP analysis indicates that both samples were below the regulatory level for Lead as a hazardous waste. The other metals were also below the applicable levels.

Immunoassay screening and subsequent laboratory analysis of soil samples indicated no significant concentrations of PCBs to be present in the site samples.

Carcinogenic PAHs were the primary organic contaminant of concern with six out of seven samples submitted for laboratory analysis significantly exceeding the screening benchmark. The highest total PAH concentration was over 120 ppm in sample TP-3S. Sample SS-4 also exhibited significantly elevated total PAH values.

In addition to the laboratory data presented in the tables and analytical data package, the data validator also reported that the chromatograms for soil samples TP-3S, TP-10D, TP-6S and SS-4 exhibited coal ash/tar C11-C22 aromatic petroleum patterns. The results exceed HSCA guidance criteria in TP-3S.

Some general information is presented below regarding several contaminants of concern detected during this investigation.

Arsenic

Arsenic was detected above screening benchmarks in soil samples across the site.

Arsenic is found naturally in the earth's crust. It is also a by-product of smelting of metals and burning of fossil fuels. The primary use of Arsenic is in weed and insect pesticides and as a wood preservative. It is also used in lead-base alloys for hardening lead used in batteries, bearings and cable and as a rust inhibitor in antifreeze. Arsenic was also historically used in the leather tanning process.

Systemic effects of Arsenic ingestion include irritation of the digestive tract, decreased production of red and white blood cells, abnormal heart function, blood vessel damage, liver and

kidney injury and impaired nerve function.

One of the most common characteristics of ingestion of inorganic Arsenic is the appearance of dark and light spots on the skin, or small corns or warts on the palms, soles and trunk. Arsenic ingestion has also been connected to increased incidence of some forms of cancer. In contrast, there is also some evidence that small amounts (normal dietary intake) of Arsenic may be beneficial to good health.

Lead

Lead was detected above residential and/or industrial screening benchmarks by XRF and laboratory analysis in several soil sample locations.

Lead is a naturally occurring metal. It has many uses, primarily in the production of batteries. It is also common in ammunition, metal products such as solder and pipes, roofing, and shielding for x-rays. Many paints used to contain Lead. It can also be produced from the burning of fossil fuels.

Lead has been classified by the EPA as a Group B2 - Probable Human Carcinogen. While there is no reference dose or slope factor value for Lead, it is desirable to minimize Lead exposure to the extent possible, especially for children who preferentially absorb it. Children are also more sensitive to Lead anemia than adults, and young children may experience subtle neurological damage without ever exhibiting classical signs of juvenile lead brain damage, such as loss of motor skills and speech. Learning ability may be impaired due to motor incoordination, lack of sensory perception or inability to concentrate.

Lead can also affect the kidneys, the central nervous system and the immune system and can cause anemia and weakness.

Usual Lead cleanup values that are commonly considered are the 400 mg/Kg residential level generally applied by the EPA as a trigger cleanup guideline. Lead in soils in residential neighborhoods above 400 mg/Kg merits further evaluation in future efforts; i.e., evaluation of blood-lead levels. The DNREC screening level for Lead in industrial soils is 1000 mg/Kg.

**Polycyclic Aromatic Hydrocarbons (Benzo (a) pyrene, Benzo(a)anthracene,
Benzo(b)fluoranthene, Indeno(1,2,3-cd)pyrene, DiBenzo(a,h)anthracene,
Benzo(k)fluoranthene)**

PAHs were detected above screening benchmarks in several of the soil and sediment samples collected throughout the site as part of this investigation.

Benzo (a) pyrene (BaP) and the others are polycyclic aromatic hydrocarbon (PAH) compounds.

They are formed during the burning of petroleum products and plant or animal materials. It is also found in coal tar, road and roofing tars and in creosote. Cigarette smoke also contains PAHs. PAHs can enter the body by breathing smoke containing the material or by ingesting it. It is not normally absorbed through the skin, but small amounts may be if the skin has contact with heavy oils containing PAHs.

PAHs have been shown to cause tumors in laboratory animals and are suspected human carcinogens.

8.0 OTHER ENVIRONMENTAL EVALUATIONS

Members of DNREC evaluated the files on the subject property for the presence of Underground Storage Tanks and Asbestos. The Hazardous Materials Summary/Cost Proposal prepared by USA Environmental Management, Inc. (USAEMI) was also reviewed.

8.1 *Underground Storage Tanks*

A memorandum describing the results of the DNREC Underground Storage Tank Branch (UST) review of the property is included in Appendix J.

Two Underground Storage Tanks (USTs), formerly containing heating oil are located in the southeastern corner of the property in the parking lot. The tank sizes are listed as 8000 and 10,000 gallon. The UST Branch has determined that these tanks must be removed or properly abandoned. No surface evidence of other USTs was noted, however the presence of other tanks couldn't be completely ruled out.

8.2 *Asbestos/Lead-based Paint*

Asbestos Containing Material (ACM) in the form of thermal insulation, floor tiles and debris was noted on the inside of the building. Some possible ACM may also be contained within the built-up roofing materials. DNREC-SIRB advises that prior to any demolition an asbestos survey via a **State of Delaware Certified Professional Firm** must be performed to identify any other possible asbestos containing materials.

Several damaged paint surfaces were tested by USAEMI for the presence of Lead. All but two samples tested contained Lead in excess of the level established by EPA as "positive". Stabilization or abatement of Lead-containing paint in the building should occur to reduce potential hazards.

8.3. Hazardous Waste

The presence of several drums of unknown material was noted in the USAEMI report. The contents of these drums should be tested to characterize the material and then the drums should be disposed of in accordance with applicable regulations.

The building contains fluorescent light fixtures that were noted in the USAEMI report. PCB containing oils were present in the ballasts associated with these light fixtures. The fluorescent tubes and PCB containing ballasts should be removed and properly disposed of in accordance with applicable regulations.

9.0 SUMMARY AND CONCLUSION

The Delaware Department of Natural Resources and Environmental Control (DNREC) Site Investigation and Restoration Branch (SIRB), in cooperation with the United States Environmental Protection Agency (EPA), conducted a Brownfield Preliminary Assessment II (BPA II) for the former George Gray Elementary School located at 2113 Thatcher Street in Wilmington, Delaware.

The former George Gray School property currently occupies an approximately 4.0± acre block on the east side of Wilmington. The information discussed in this report is confined to the property only.

The primary proposed reuse of the building is a Charter School. This adaptive reuse of the building would include the additions of a culinary arts school and possible catering business, a community banquet and conference center and two cafes. Also proposed are a day care center and a recording studio.

The purpose of the Brownfield Preliminary Assessment II was to investigate the possible existence of released hazardous substances at the George Gray School property through the collection and analysis of environmental samples. The media sampled included surface soils and deep soils. Soil samples were field screened by the DNREC SIRB Analytical Chemist and selected samples were submitted to the DNREC Division of Water Resources Environmental Services Laboratory for analysis of specified parameters.

The analytical data generated from the collection and laboratory analysis of the environmental samples was subsequently evaluated to determine the potential for human and environmental exposures to hazardous substances.

After the completion of the BPA II, DNREC submitted the report to the EPA and State officials who will decide whether the site should undergo further investigation or obtain a "No Further Action" (NFA) designation under the Federal Superfund and/or State Site Investigation & Restoration Branch Programs.

The BPA II is intended to provide a general characterization of the environmental conditions present at the site and does not provide a 100% complete surface and subsurface assessment of the project area or individual properties. The assessments contained within are based solely on conditions at the time of sampling and the specific locations evaluated.

As part of the BPA II, 11 test pits were excavated and 30 shallow and deep soil samples were collected. Test pit logs from the George Gray School investigation indicate that the subject site has received fill materials including sands, silts, clays, gravels, rock, bricks, wood, metal, coal and coal ash, incinerator ash, slags, concrete, and glass and other miscellaneous trash and debris. Depths of fill materials encountered ranged from 2 to 13 feet.

The groundwater at the George Gray School site is not used for domestic or public water supply. Generally, the groundwater flow direction is inferred to be toward the south and west, towards the Brandywine Creek. However, several large (6 to 9 foot diameter) combined sewer lines are present on or near the property and may affect groundwater flow direction.

The groundwater table at the George Gray property is highly variable. Groundwater was encountered in just 5 of the 11 test pits excavated on site, on top of the original marsh and streambed deposit.

No groundwater samples were collected during this phase of the investigation. Historical review of the property indicates no significant sources of contamination other than filling of low lands. In addition, there are no known groundwater targets in the area.

There is no surface water on or directly bordering the site.

The Brandywine Creek is located approximately 900 feet west of the subject property. Surface water coming from the site is expected to flow into the Brandywine Creek through overland flow, or into a combined sanitary and storm sewer system operated by the City of Wilmington. During major storm events, excess water may discharge to the river from Combined Sewer Overflows (CSO) located along the Brandywine Creek, just north of Northeast Boulevard.

No surface water or sediment samples were collected during this investigation due to a lack of a direct surface water pathway.

The property is mostly unfenced and access is unrestricted on the majority of the property. The south parking area is paved and fenced and most of the remaining property is grass covered.

Soil samples were collected from 11 test pits locations throughout the site area. Soil samples were field screened for PCBs and PAHs and related pesticides using immunoassay test kits and for metals using XRF.

Based on the results of field screening, soil samples from the George Gray School property exhibited elevated concentrations of some metals, most notably Arsenic and Lead. Arsenic and

Lead were both detected in shallow and deep test pit soil samples in excess of screening benchmarks.

Elevated Arsenic and Lead concentrations were confirmed by laboratory analysis of selected samples. Five out of six soil samples submitted to the laboratory exhibited Arsenic concentrations greater than screening benchmarks, with a high of 40.8 mg/Kg. Five out of six soil samples submitted to the laboratory contained Lead at concentrations above the benchmark for residential soil (URS) and two of these exceeded the Industrial soil URS. The highest concentration of Lead detected was 1510 mg/Kg. The highest Lead concentrations were detected in test pits TP-4 and TP-9 and were associated with coal or incinerator ash found in the test pits.

Iron, Manganese and Zinc were also detected in soil samples at concentrations greater than the residential URS and/or RBC's.

Two samples were submitted for TCLP metals analysis. TCLP analysis indicates that both samples were below the regulatory level for Lead as a hazardous waste. The other metals were also below the applicable levels.

Immunoassay screening and subsequent laboratory analysis of soil samples indicated no significant concentrations of PCBs to be present in the site samples.

Carcinogenic PAHs were the primary organic contaminant of concern with six out of seven samples submitted for laboratory analysis significantly exceeding the screening benchmark. The highest total PAH concentration was over 120 ppm in sample TP-3S. Sample SS-4 also exhibited significantly elevated total PAH values.

In addition to the laboratory data presented in the tables and analytical data package, the data validator also reported that the chromatograms for soil samples TP-3S, TP-10D, TP-6S and SS-4 exhibited coal ash/tar C11-C22 aromatic petroleum patterns. The results exceed HSCA guidance criteria in TP-3S.

A review of the George Gray School property was also undertaken by representatives from the DNREC Underground Storage Tank Branch (UST) and Air Resources Branch in order to evaluate the presence or absence of underground storage tanks or asbestos. In addition, USAEMI performed a hazardous materials evaluation of the building structure. Along with the issues related to testing of environmental media, these assessments have resulted in the following recommendations:

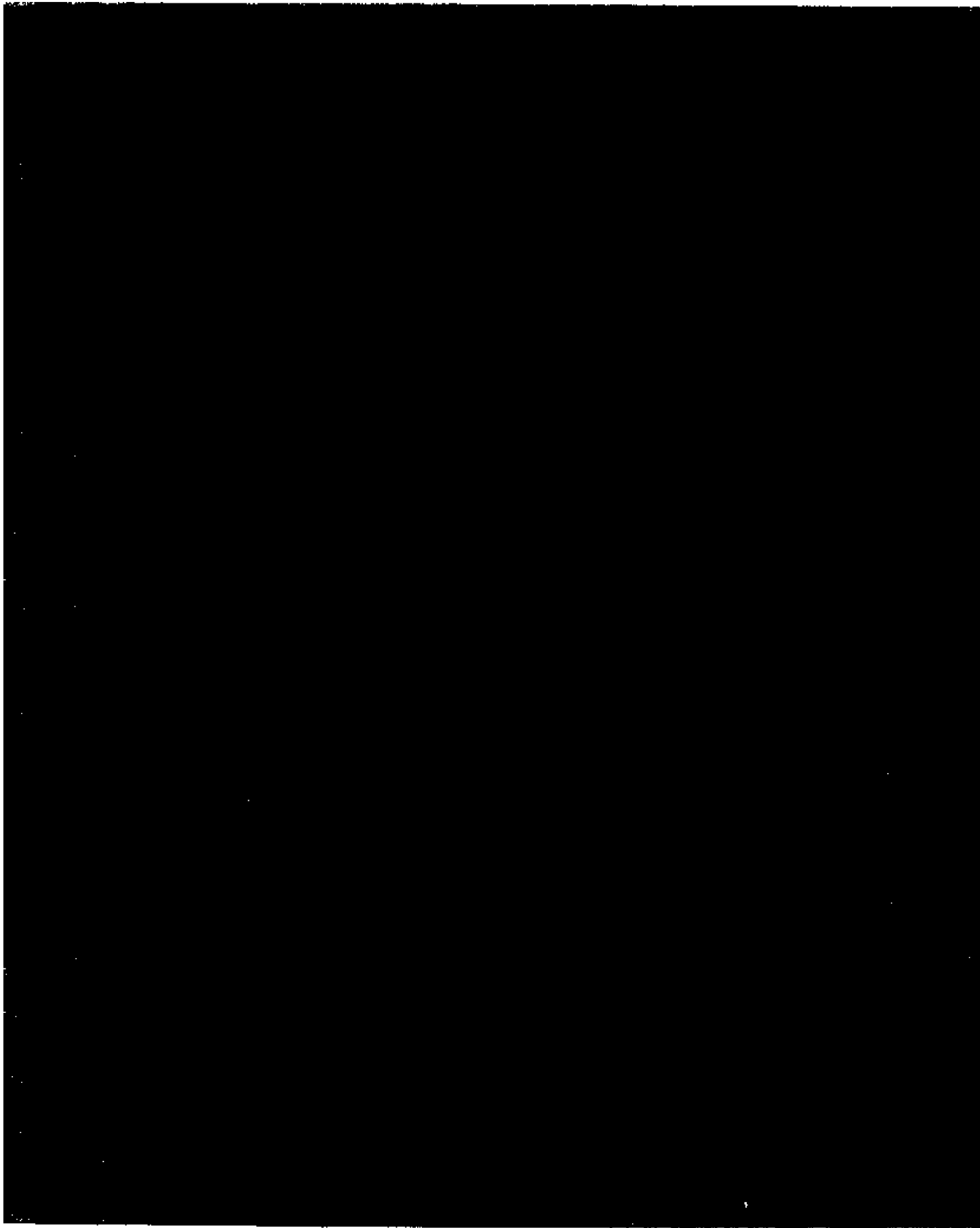
- Two Underground Storage Tanks (USTs), formerly containing heating oil are located in the southeastern corner of the property in the parking lot. The tank sizes are listed as 8000 and 10,000 gallon. The UST Branch has determined that these tanks must be removed or properly abandoned and the surrounding soil sampled for contamination. No surface evidence of other USTs was noted, however the presence of other tanks couldn't be completely ruled out.

- Asbestos Containing Material (ACM) in the form of thermal insulation, floor tiles and debris was noted on the inside of the building. Some possible ACM may also be contained within the built-up roofing materials. DNREC-SIRB advises that prior to any demolition an asbestos survey via a **State of Delaware Certified Professional Firm** must be performed to identify any other possible asbestos containing materials.
- Several damaged paint surfaces were tested by USAEMI for the presence of Lead. All but two samples tested contained Lead in excess of the level established by EPA as “positive”. Stabilization or abatement of Lead-containing paint in the building should occur to reduce potential hazards.
- The presence of several drums of unknown material was noted in the USAEMI report. The contents of these drums should be tested to characterize the material and then the drums should be disposed of in accordance with applicable regulations.
- The building contains fluorescent light fixtures that were noted in the USAEMI report. PCB containing oils were present in the ballasts associated with these light fixtures. The fluorescent tubes and PCB containing ballasts should be removed and properly disposed of in accordance with applicable regulations.

Based upon the information collected from the Brownfield Preliminary Assessment II at the former George Gray Elementary School, the DNREC SIRB identified the following issues and concerns, which need to be addressed with DNREC oversight:

- Based upon the contaminants detected in the on-site soils, there is potential exposure of people to contaminated soil through inadvertent ingestion and airborne dust, primarily during excavation,
- Potential exposure of workers to contaminated soils during excavation and construction especially in the area containing Lead and PAH concentrations,
- Two heating oil USTs are out of compliance and must be removed and the surrounding soil sampled and analyzed,
- Remediation and proper disposal of the asbestos containing materials and lead containing paint should be completed,
- Removal and proper disposal of fluorescent tubes and PCB containing oil and ballasts should be completed.

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Figure 16: Soil Sample Locations at the George Gray School	40

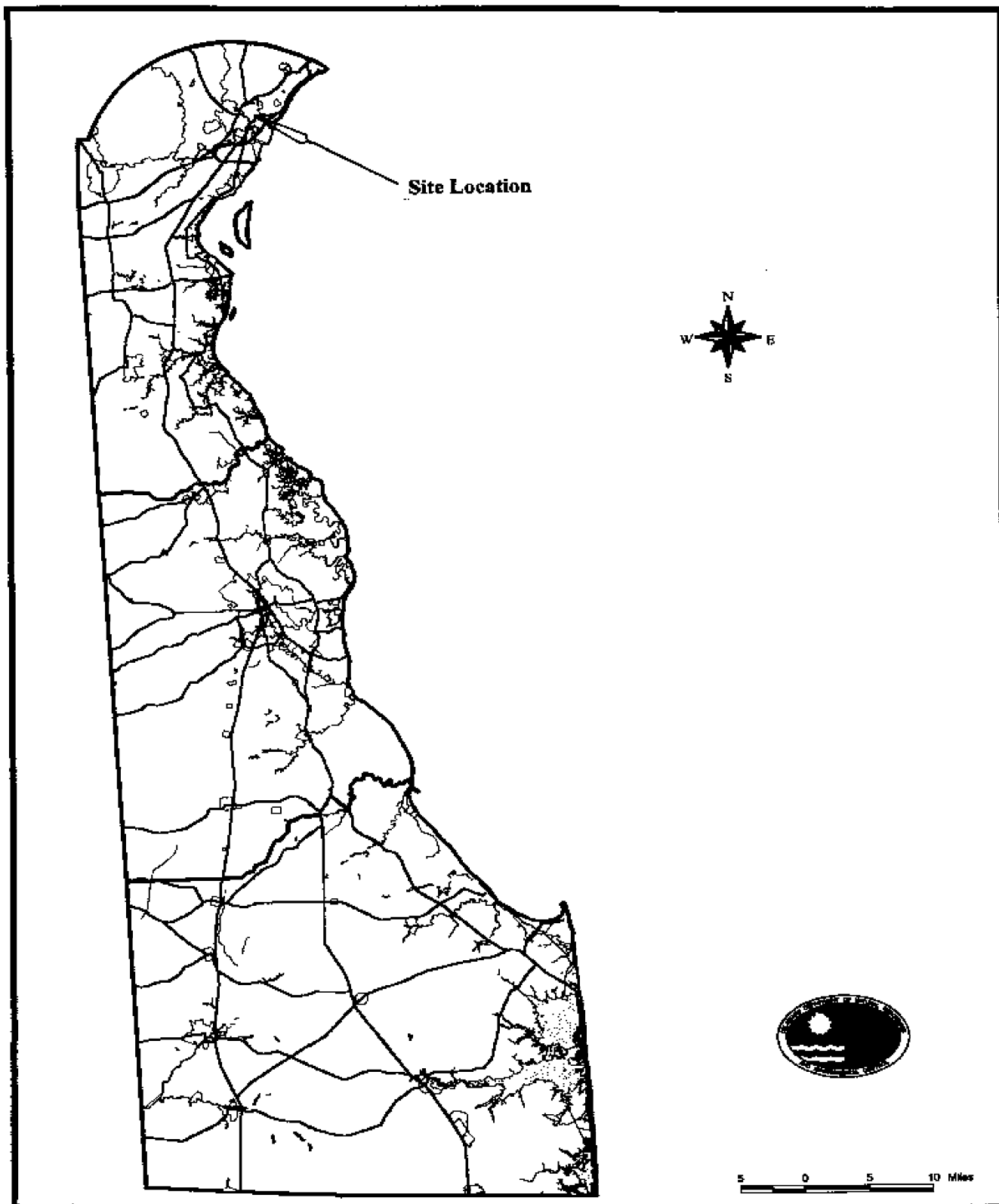


Figure 1: Location of the George Gray School in the State of Delaware

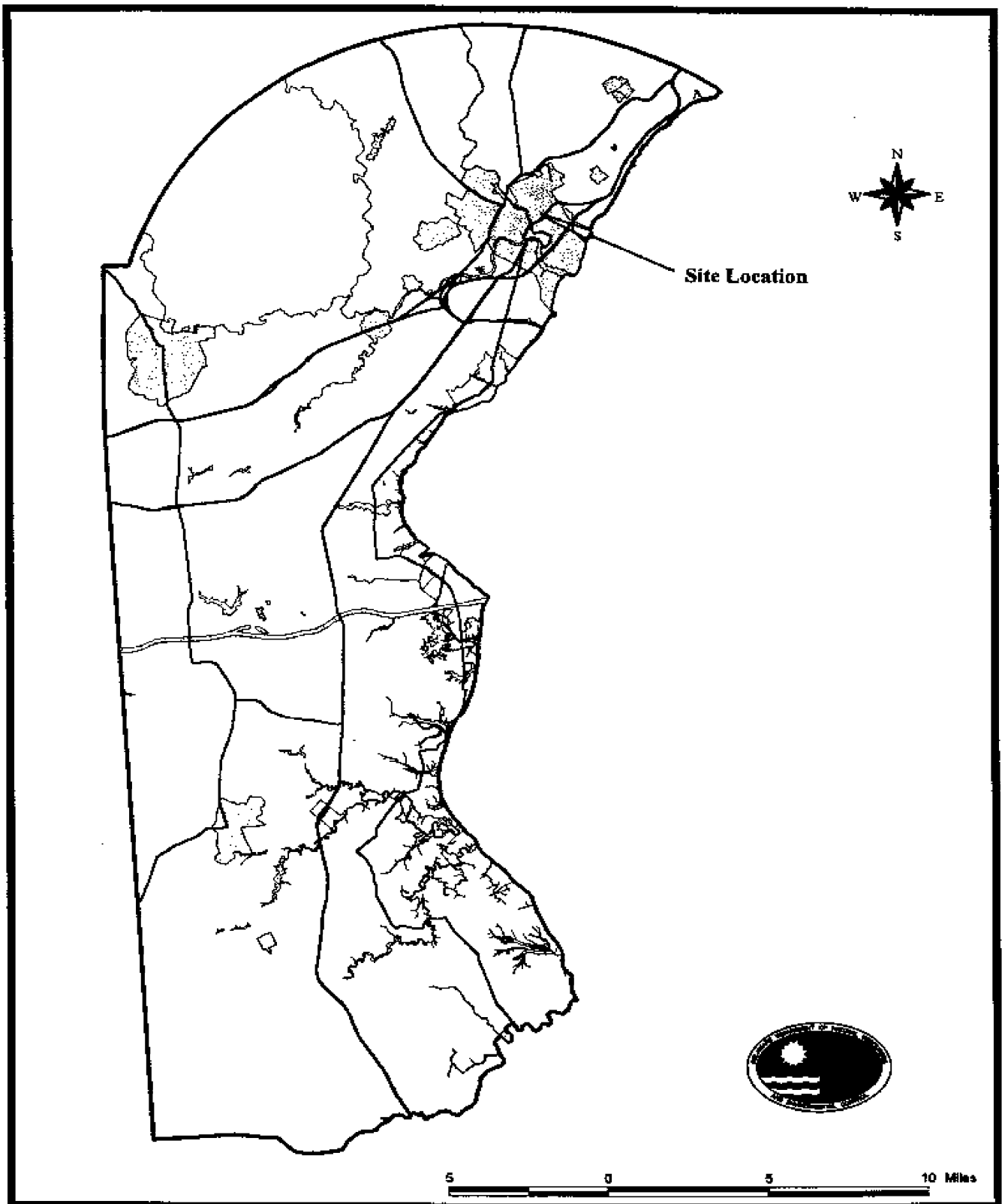


Figure 2: Location of the George Gray School in New Castle County

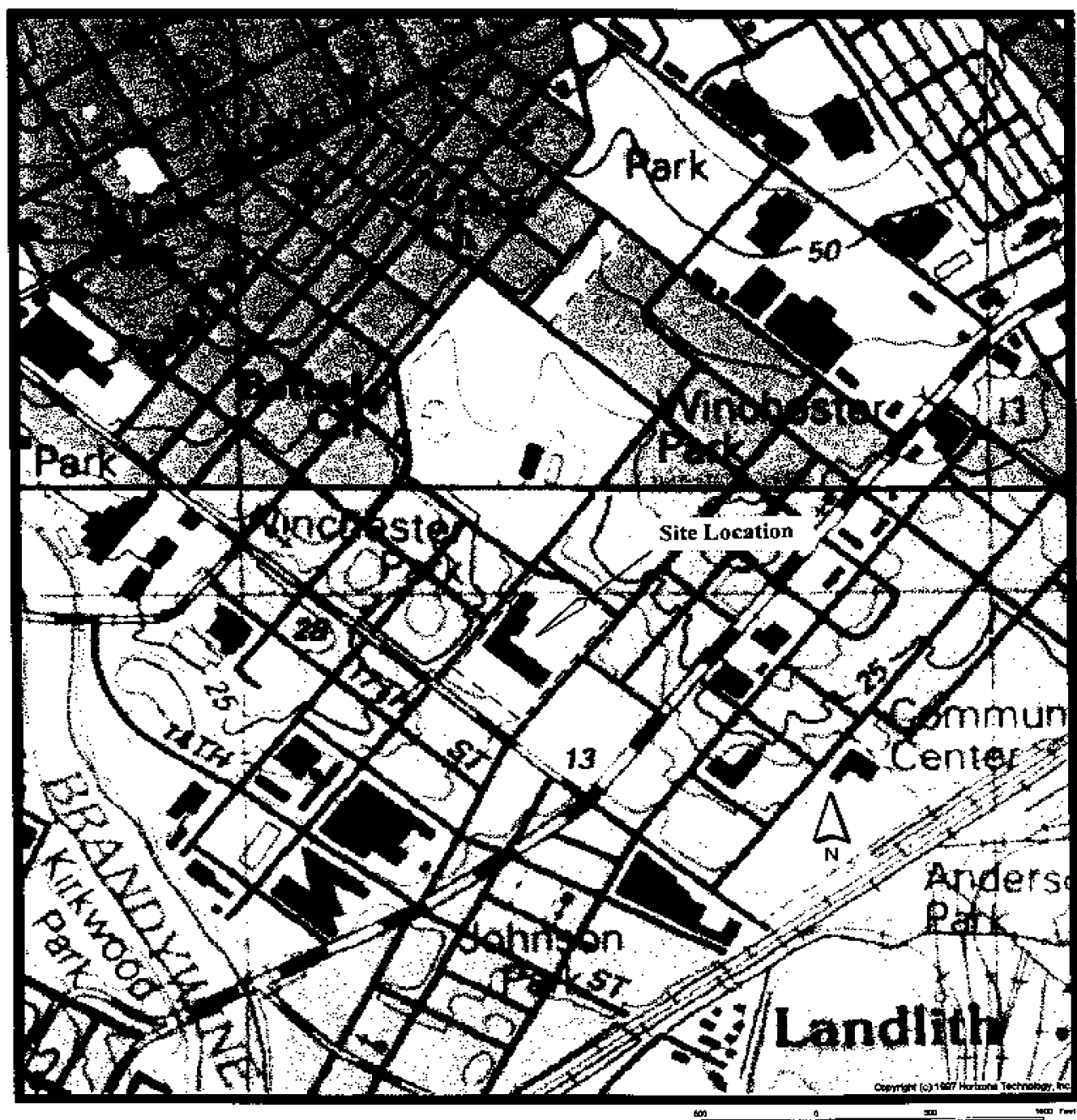
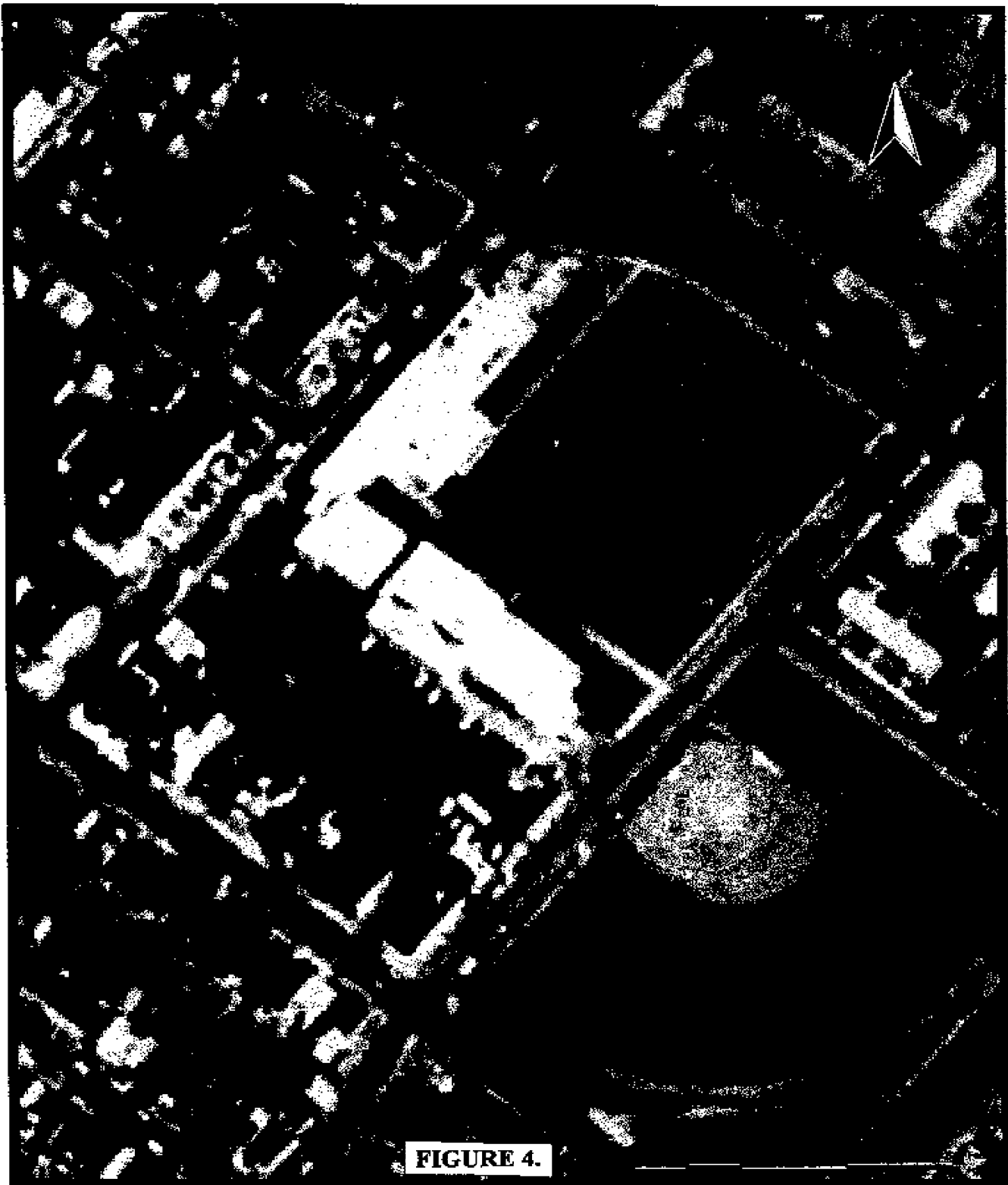


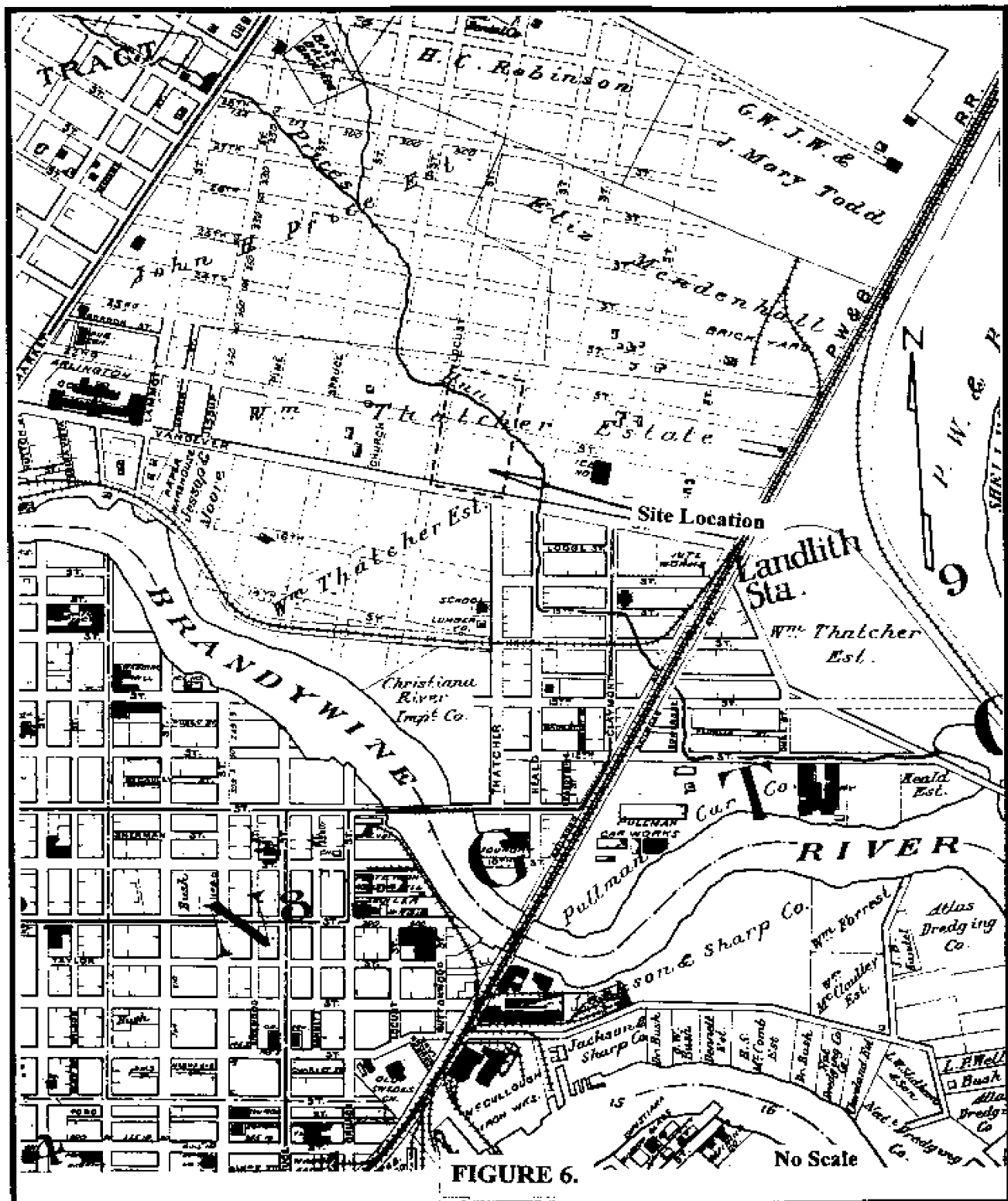
FIGURE 3. Location of George Gray School, Wilmington, Delaware



Orthophotoquad of the George Gray School Property



FIGURE 5.



Historical Map of the George Gray School Area—1893
(from the 1893 Map of New Castle County by G. Wm. Baist, Phila. Pa.)

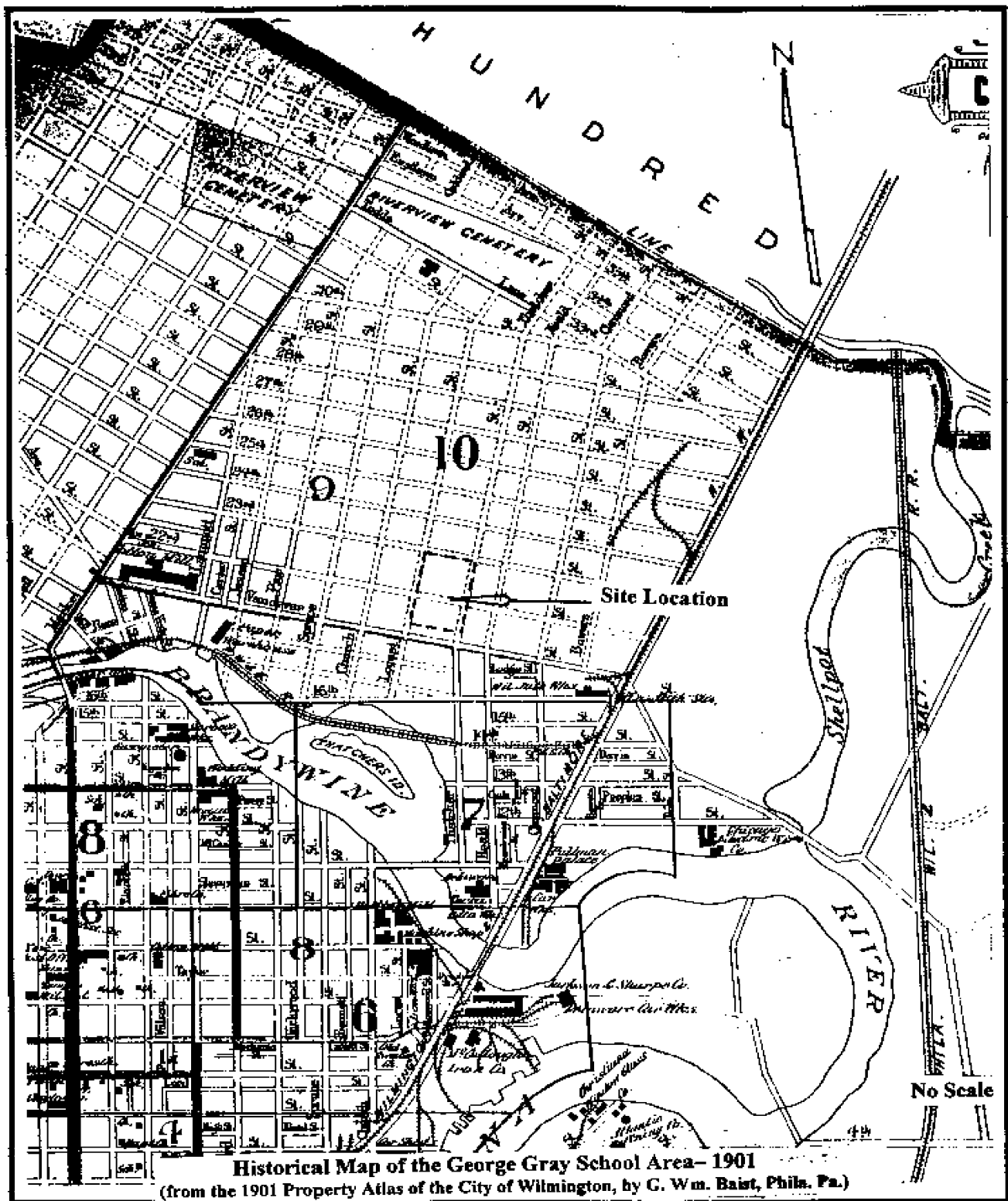


FIGURE 7.

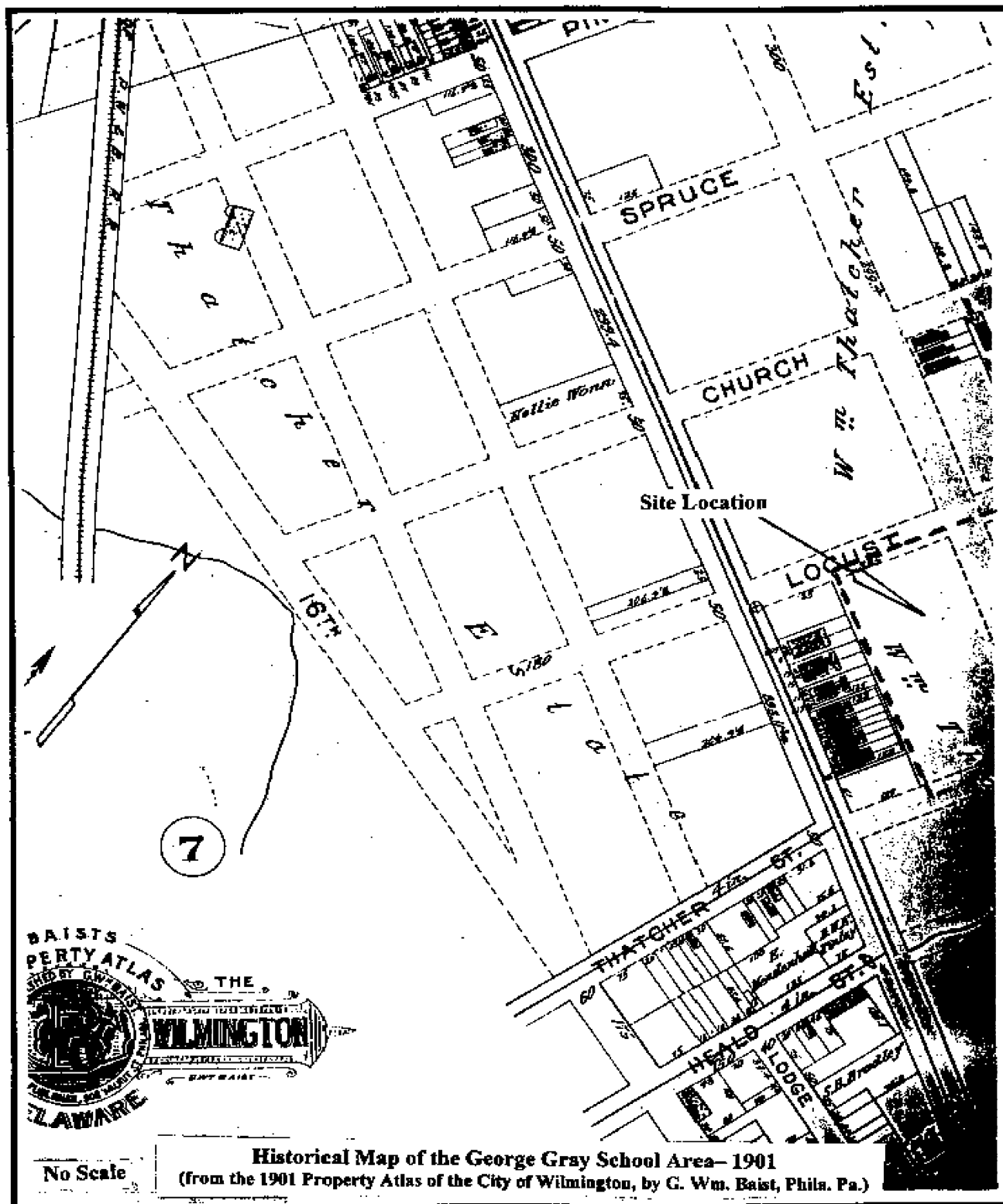
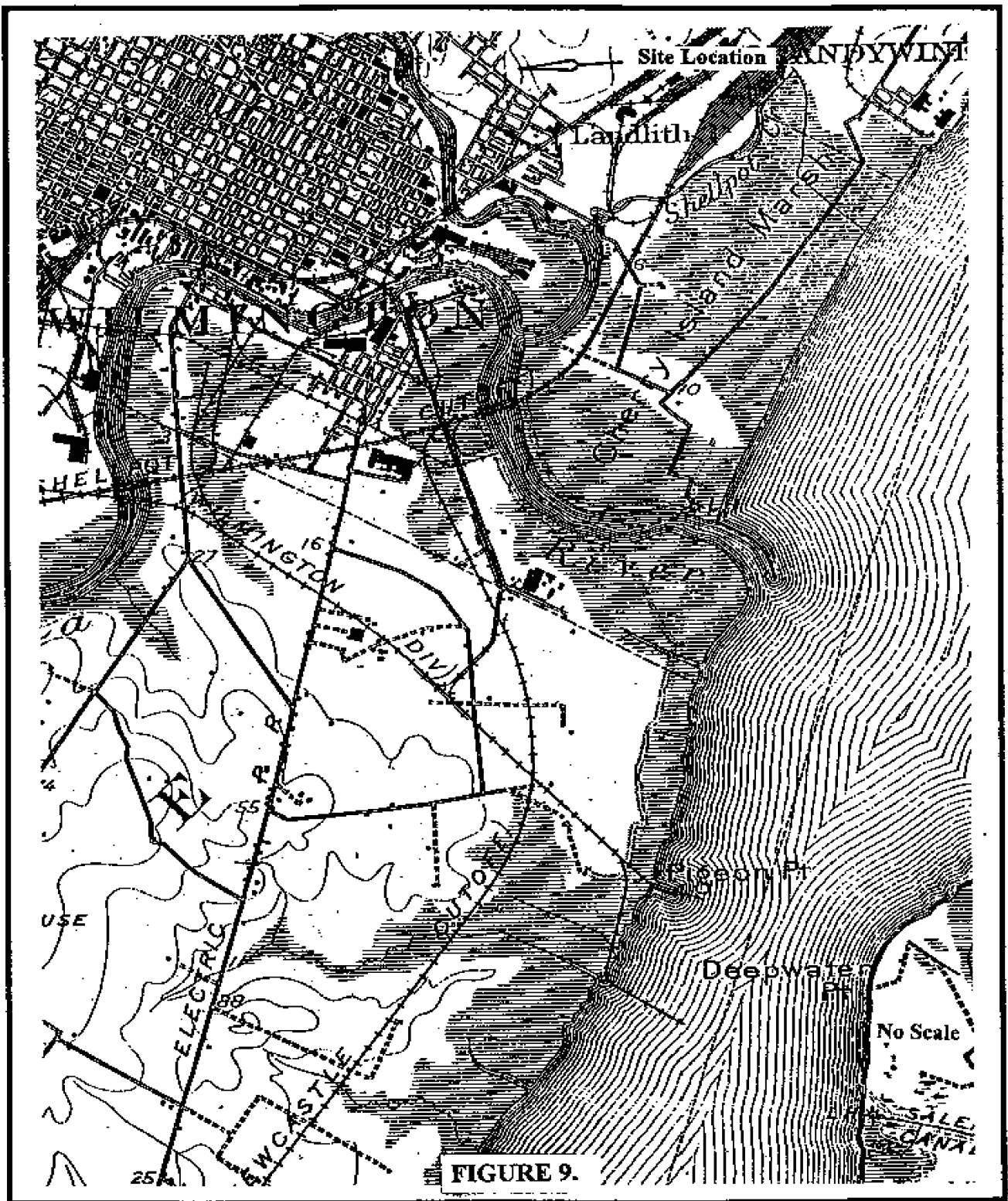
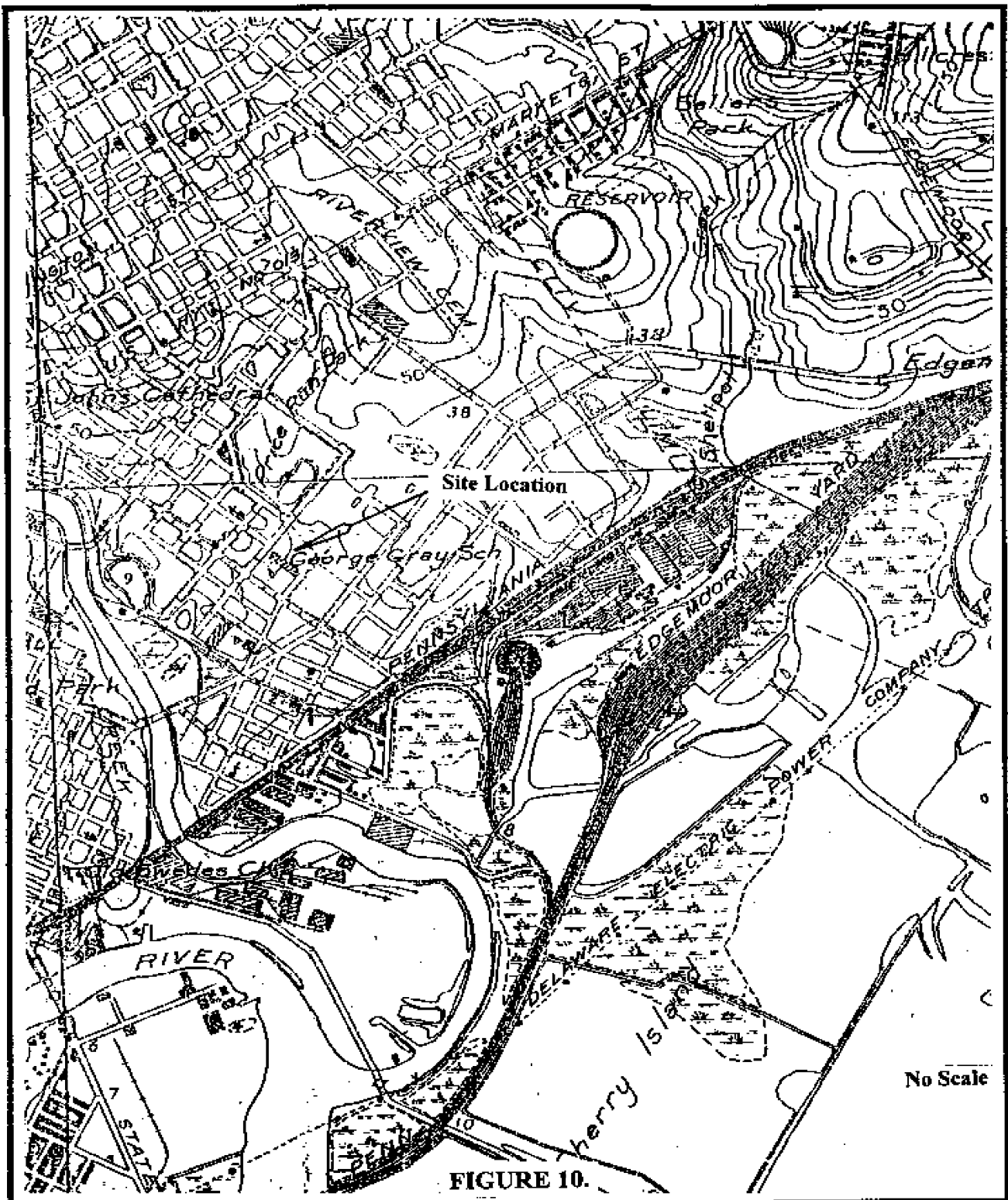
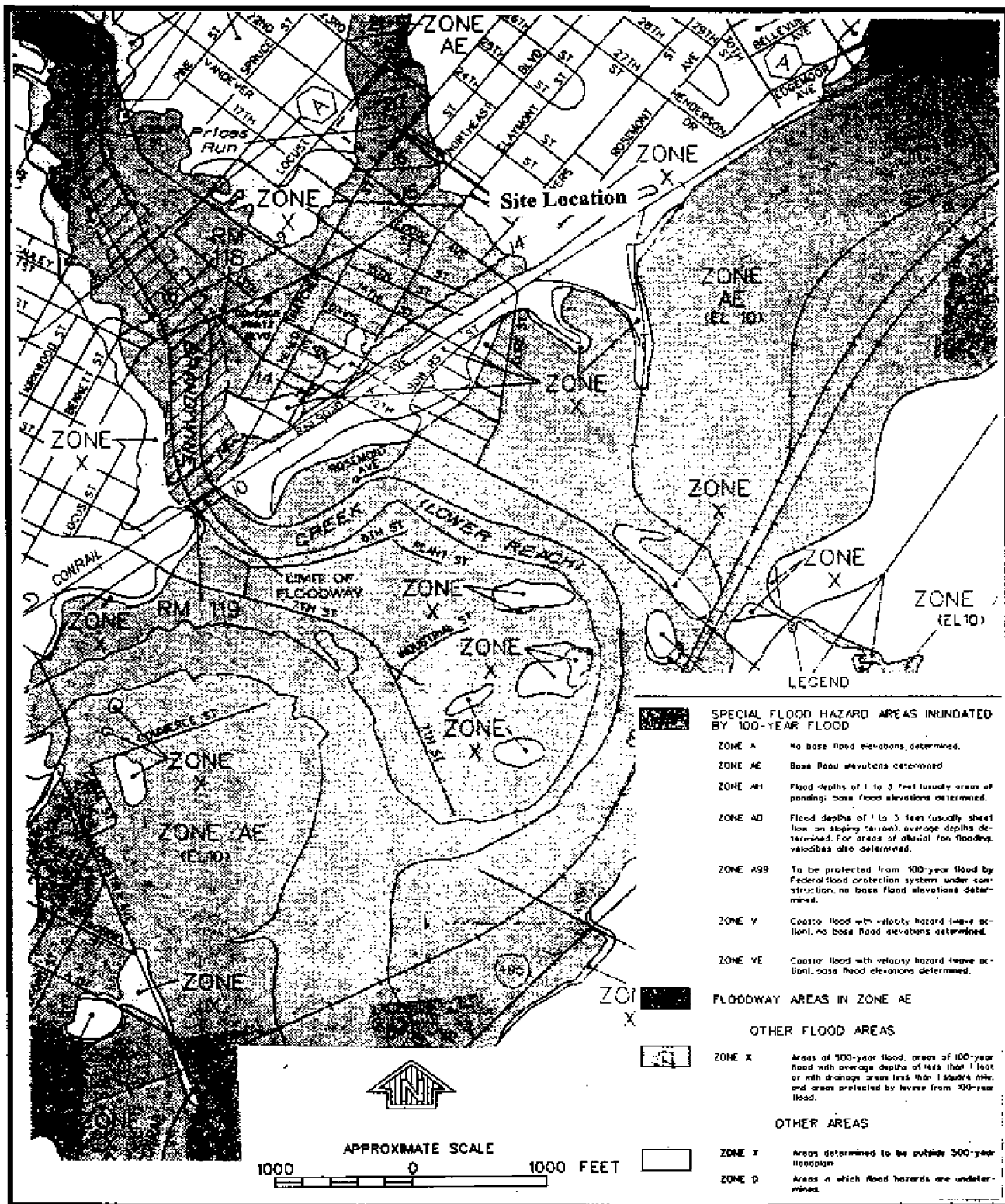


FIGURE 8.



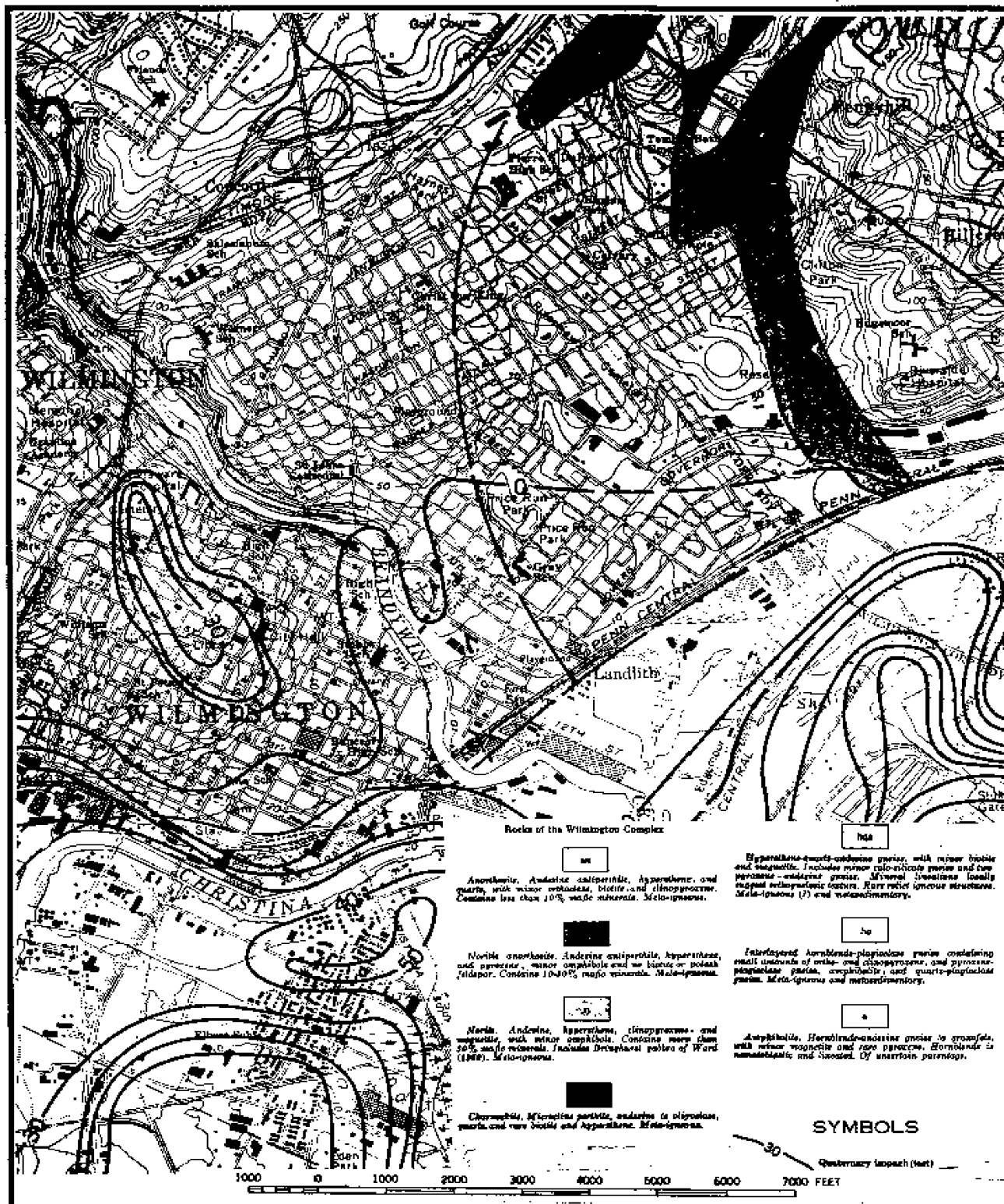
Topographic Map (1906)





Flood Insurance Rate Map, George Gray School
(from the National Flood Insurance Program, 1996)

FIGURE 11.



Geology of the George Gray School Area
(from Geology of the Wilmington, Area, Delaware, Delaware Geological Survey, Woodruff, K.D. and A.M. Thompson, 1975)
FIGURE 12.



- a** 0-20 feet: Areas where slopes exceed 25 percent. Regolith tends to be thin and stoney with unweathered rock fragments.
- b** 0-20 feet: Areas of gentle slopes with grades less than 8 percent. These areas are typically underlain by Wilmington Complex rocks which tend to be more resistant to physical and chemical weathering than the other rocks of the Piedmont.
- c** 20-50 feet: This is the average regolith thickness in the Piedmont. Lithology commonly ranges from sandy silt to silty clay, with unweathered rock fragments less common than "b" above. Slopes are moderate to gentle—less than 15 percent and seldom exceeding 8 percent.
- d** 50-80 feet: Above average regolith thickness. Although slopes are normally 3 percent to 5 percent, they may be as high as 12 percent.
- e** > 80 feet: Flat-lying areas and gently sloping hillcrests with slopes less than 5 percent.

Thickness of the Regolith - George Gray School Area

(from Thickness of the Regolith in the Delaware Piedmont, Delaware Geological Survey, Christopher, M.J. and K.D. Woodruff, 1982)

FIGURE 13.



FIGURE 14.



Figure 15. Wetlands in the Area of the George Gray School

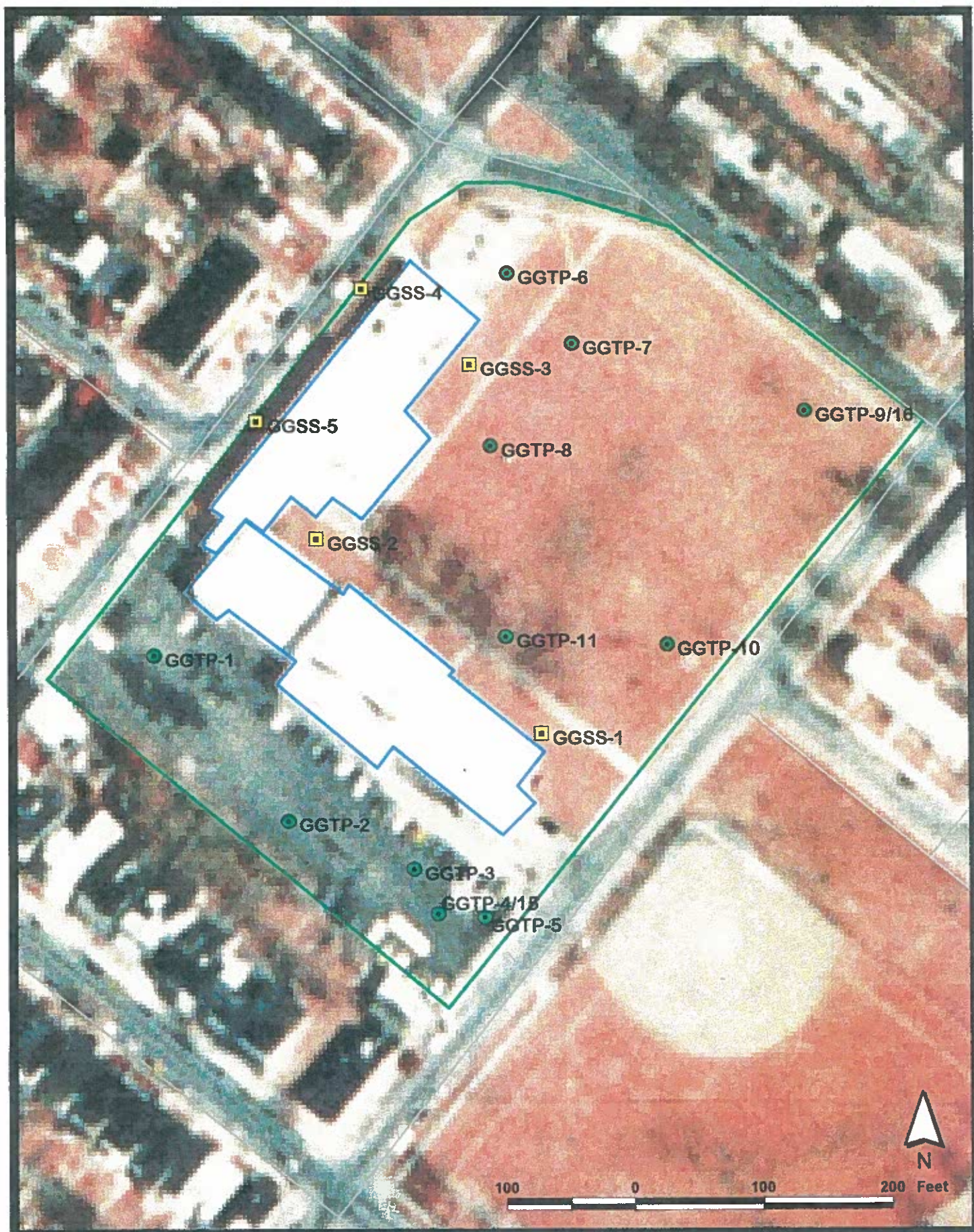
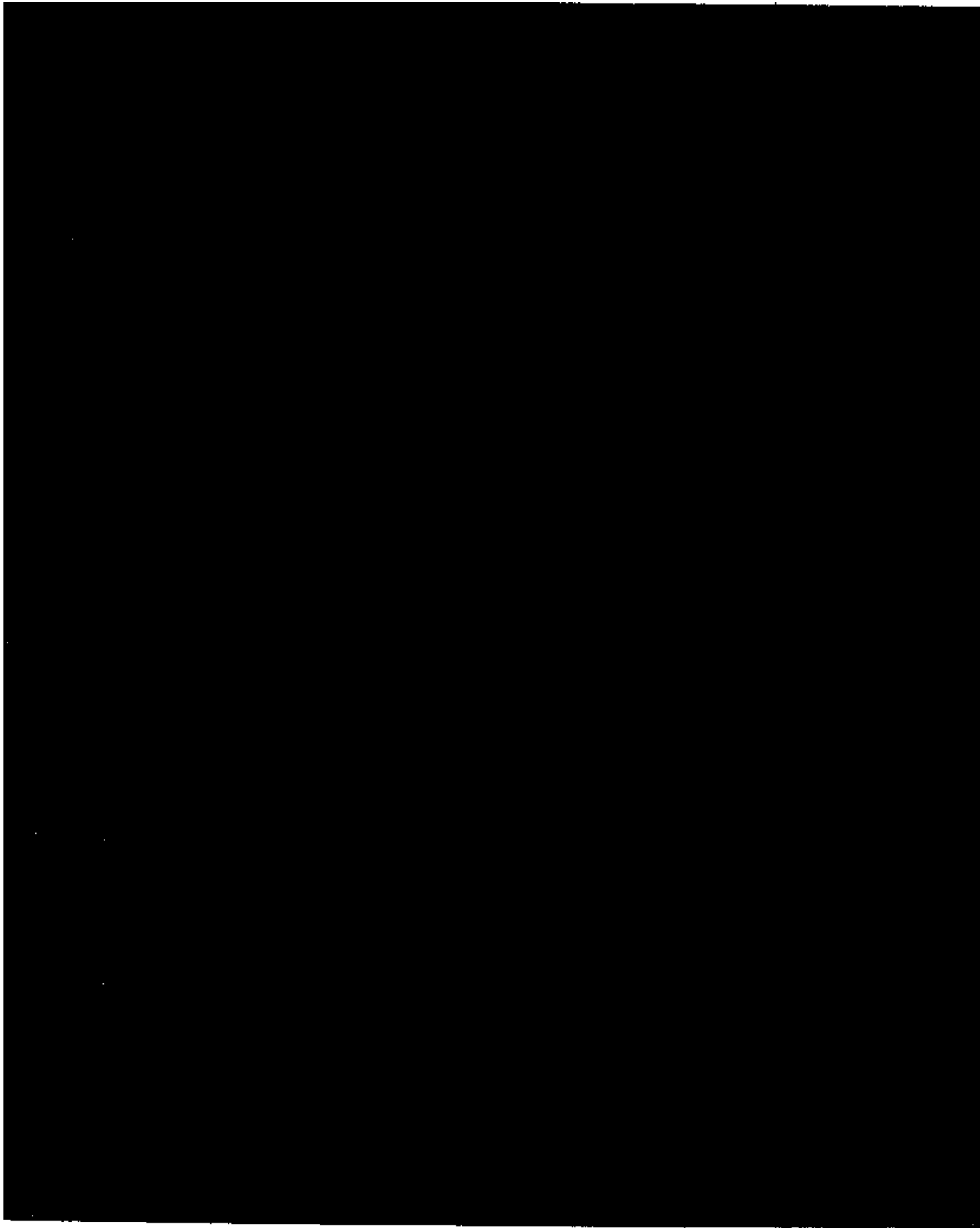


Figure 16. Soil Sample Locations at the George Gray School

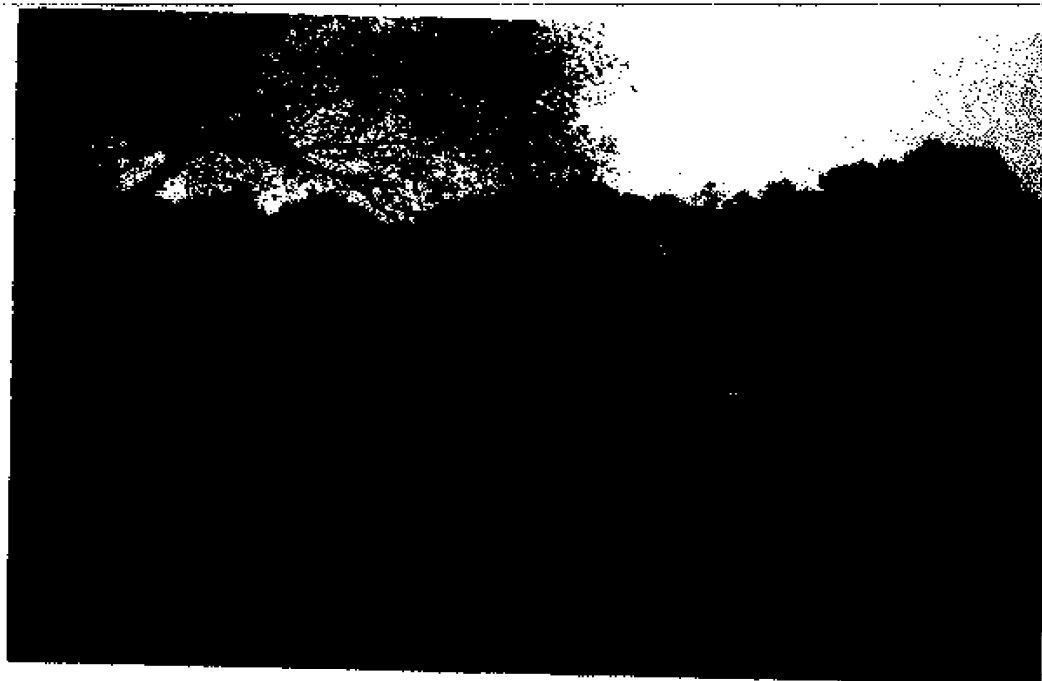


PHOTOGRAPHS

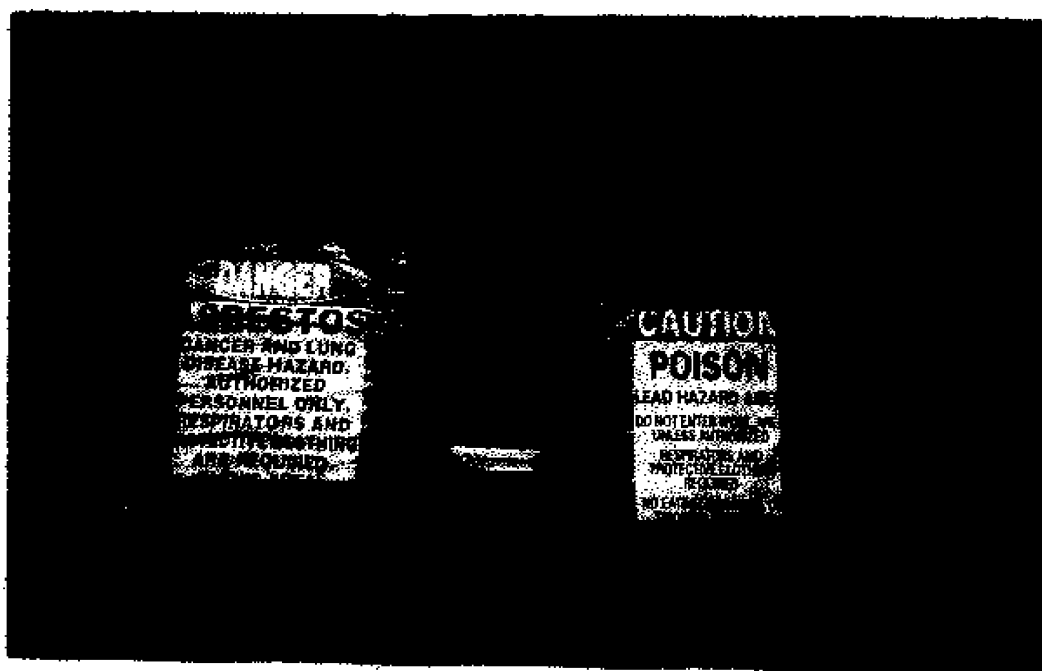
Photograph 1.	South Parking Lot – George Gray School
Photograph 2.	Field - North East Side of School
Photograph 3.	Hazard Signs for Asbestos and Lead – Inside Remediation
Photograph 4.	Test Pit #1, Native Material
Photograph 5.	Test Pit #4, Coal/Incinerator Ash Material
Photograph 6.	Test Pit #10, Clay and Peat Layer 16' Level
Photograph 7.	Test Pit #9, Ash and Brick Layer, 0-3' Level
Photograph 8.	Test Pit #9, Gray Ash Layer 7-11'



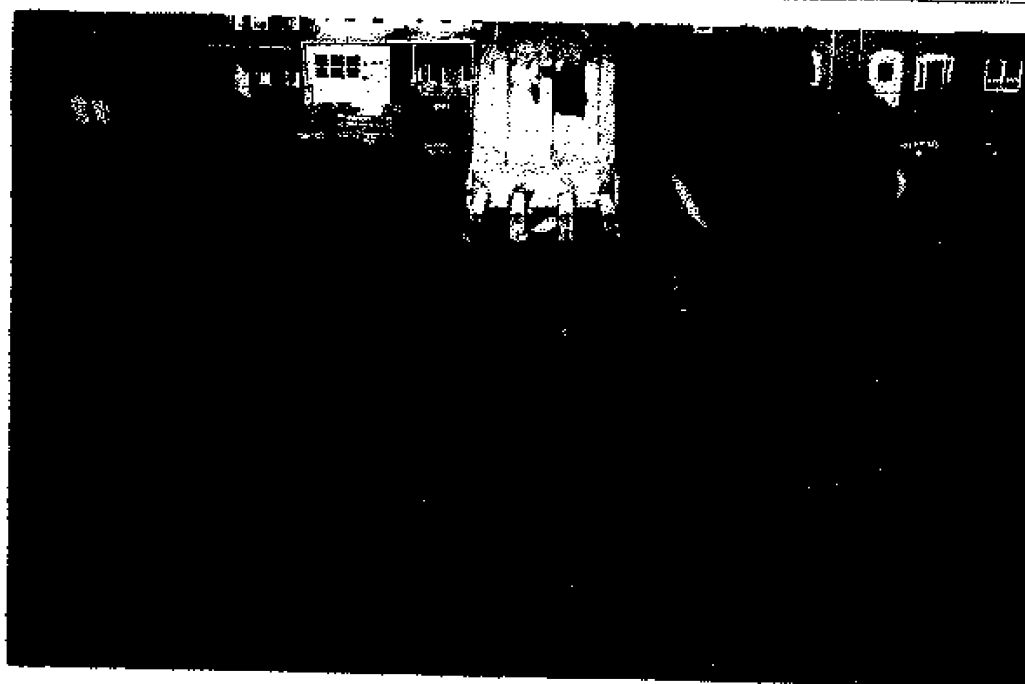
Photograph 1: South parking lot – George Gray School



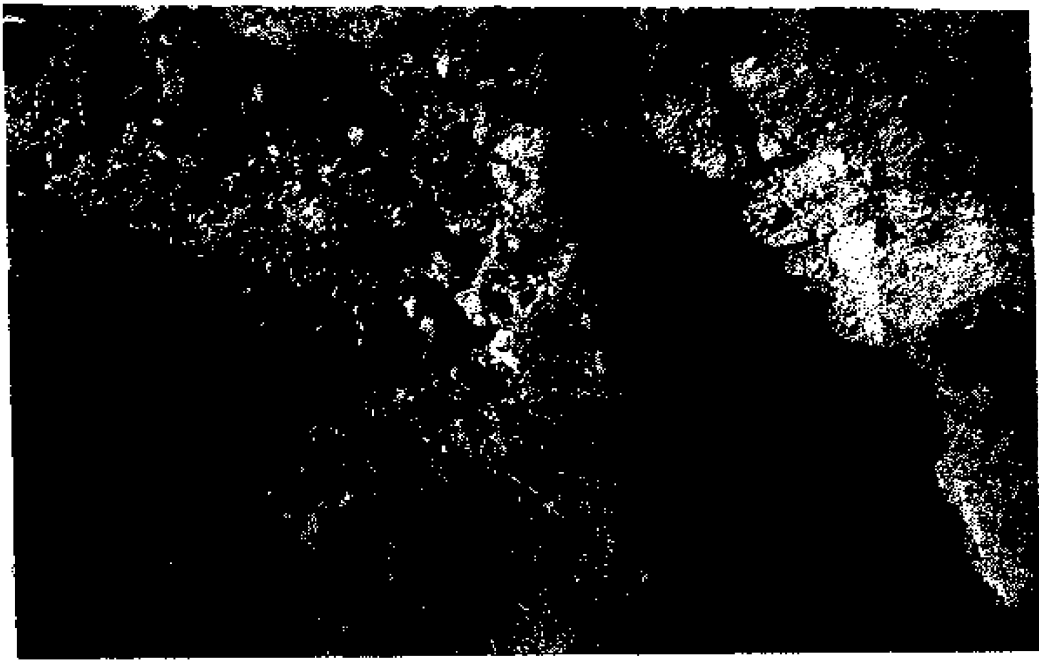
Photograph 2: Field – Northeast side of school



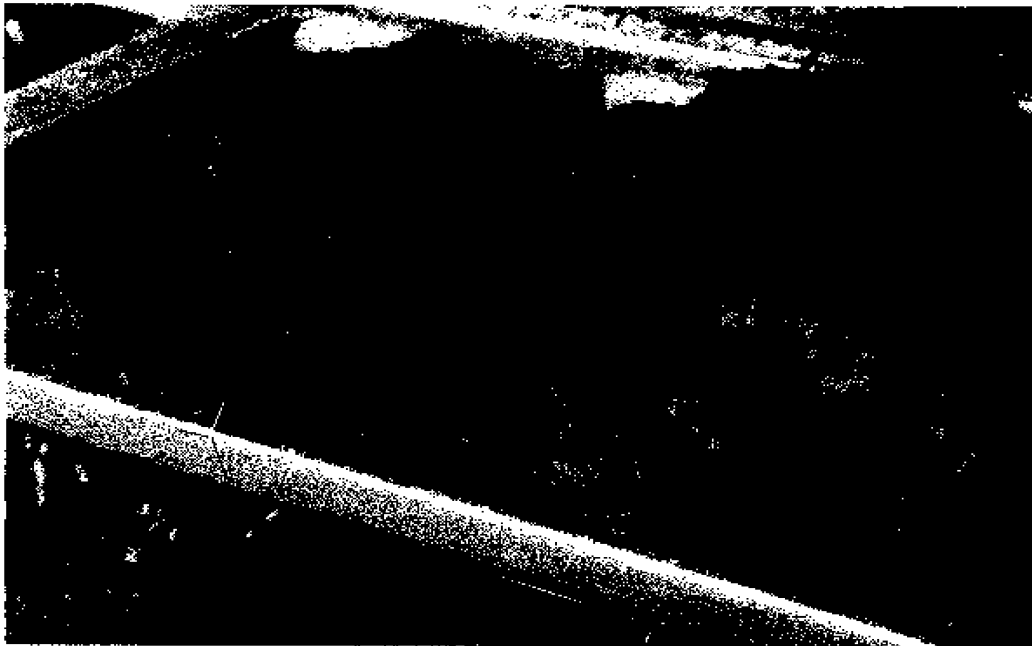
Photograph 3: Hazard signs for asbestos and lead – inside remediation



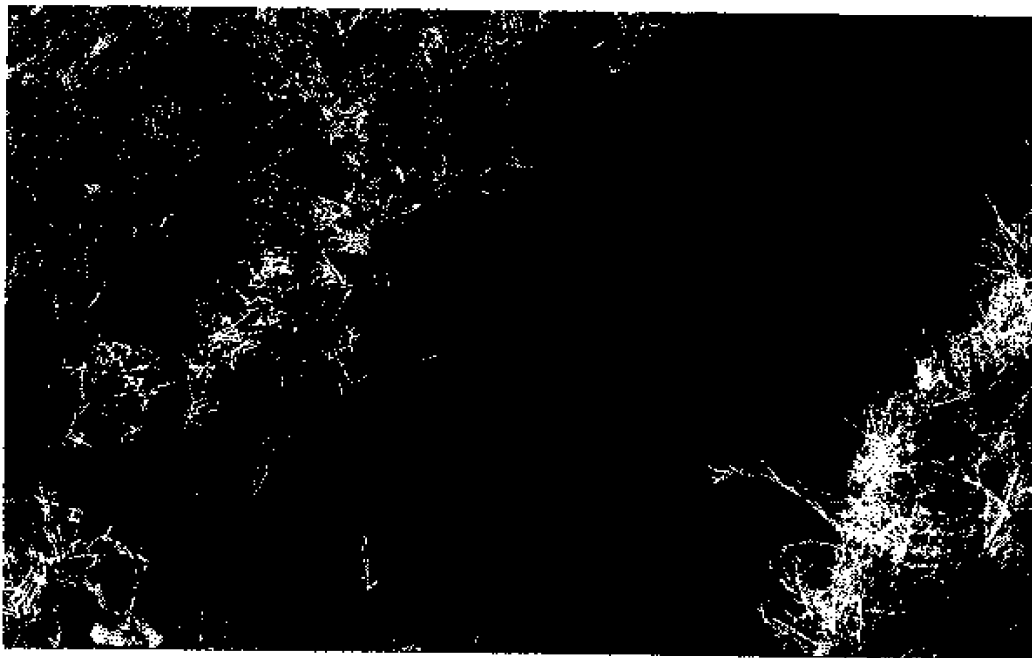
Photograph 4: Test Pit #1, native material



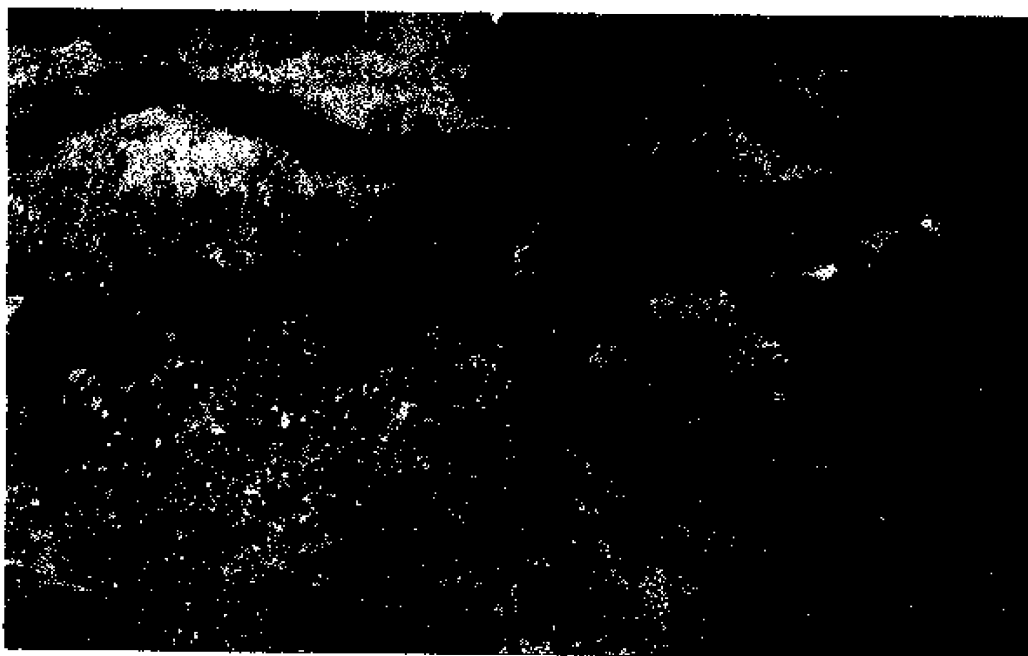
Photograph 5: Test Pit #4, coal/incinerator ash material



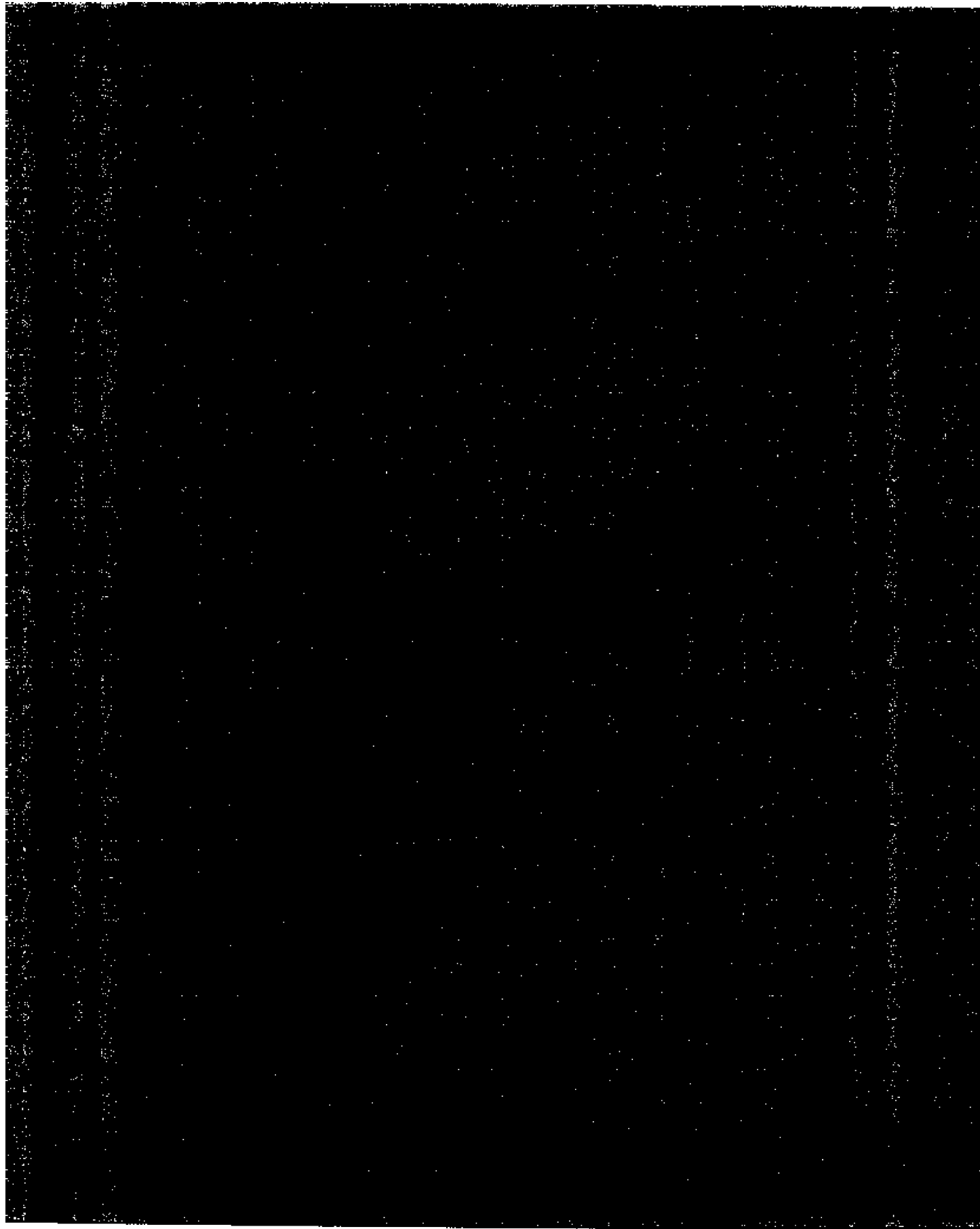
Photograph 6: Test Pit #10, clay and peat layer 16' level

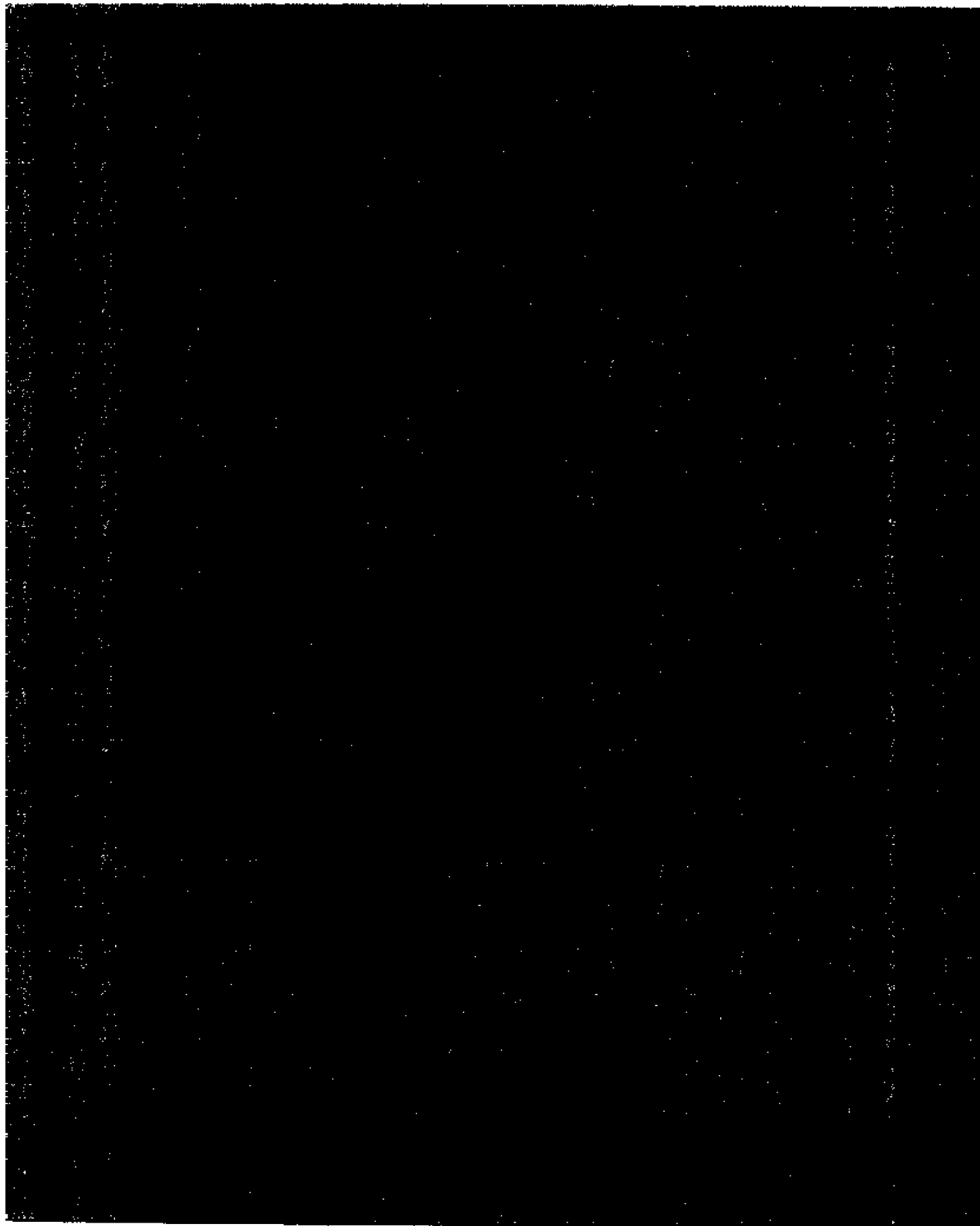


Photograph 7: Test Pit #9, ash and brick layer, 0-3' level



Photograph 8: Test Pit #9, gray ash layer 7-11'





TAL METALS

Aluminum	Cobalt	Potassium
Antimony	Copper	Selenium
Arsenic	Iron	Silver
Barium	Lead	Sodium
Beryllium	Magnesium	Thallium
Cadmium	Manganese	Vanadium
Calcium	Mercury	Zinc
Chromium	Nickel	Cyanide

TCL VOLATILES

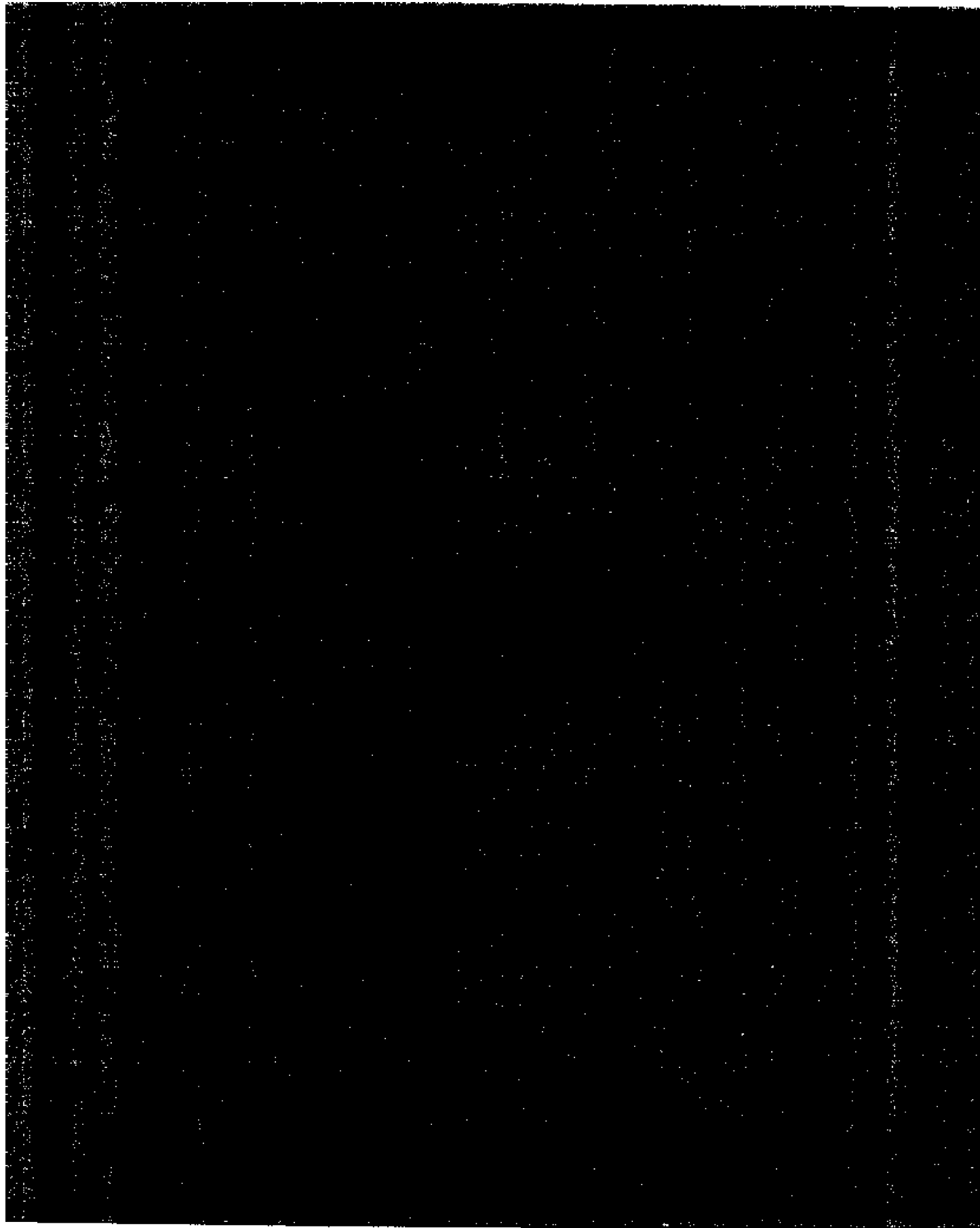
Chloromethane	2-Butanone	2-Hexanone
Bromomethane	Bromochloromethane	Tetrachloroethene
Vinyl Chloride	1,1,1-Trichloroethane	1,2-Dibromoethane
Chloroethane	Carbon Tetrachloride	Toluene
Methylene Chloride	Bromodichloromethane	1,1,2,2-Tetrachloroethane
Acetone	1,2-Dichloropropane	Chlorobenzene
Carbon Disulfide	cis-1,3-Dichloropropene	Ethylbenzene
1,1-Dichloroethene	Trichloroethene	Styrene
1,1-Dichloroethane	Dibromochloromethane	Xylenes (total)
1,2,2-Dichloroethene (total)	1,1,2-Trichloroethane	1,2-Dibromo-3-chloropropane
cis-1,2-Dichloroethene	Benzene	1,3-Dichlorobenzene
trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	1,4-Dichlorobenzene
Chloroform	Bromoform	1,2-Dichlorobenzene
1,2-Dichloroethane	4-Methyl-2-pentanone	1,2,4-Trichlorobenzene

TCL SEMIVOLATILES

Phenol	4-Chloro-3-methylphenol	N-Nitrosodiphenylamine
bis(2-Chloroethyl) ether	2-Methylnaphthalene	4-Bromophenyl-phenyl ether
2-Chlorophenol	Hexachlorocyclopentadiene	Hexachlorobenzene
1,3-Dichlorobenzene	2,4,6-Trichlorophenol	Pentachlorophenol
1,4-Dichlorobenzene	2,4,5-Trichlorophenol	Phenanthrene
1,2-Dichlorobenzene	2-Chloronaphthalene	Anthracene
2-Methylphenol	2-Nitroaniline	Carbazole
2,2'-oxybis(1-Chloropropane)	Dimethylphthalate	Di-n-butylphthalate
4-Methylphenol	Acenaphthylene	Fluoranthene
N-Nitroso-di-n-propylamine	2,6-Dinitrotoluene	Pyrene
Hexachloroethane	3-Nitroaniline	Butylbenzylphthalate
Nitrobenzene	Acenaphthene	3,3'-Dichlorobenzidine
Isophorone	2,4-Dinitrophenol	Benzo(a)anthracene
2-Nitrophenol	4-Nitrophenol	Chrysene
2,4-Dimethylphenol	Dibenzofuran	bis(2-Ethylhexyl)phthalate
bis(2-Chloroethoxy) methane	2,4-Dinitrotoluene	Di-n-octylphthalate
2,4-Dichlorophenol	Diethylphthalate	Benzo(b)fluoranthene
1,2,4-Trichlorobenzene	4-Chlorophenyl-phenyl ether	Benzo(k)fluoranthene
Naphthalene	Fluorene	Benzo(a)pyrene
4-Chloroaniline	4-Nitroaniline	Indeno(1,2,3-cd)pyrene
Hexachlorobutadiene	4,6-Dinitro-2-methylphenol	Dibenz(a,h)anthracene
		Benzo(g,h,i)perylene

TCL PESTICIDES / PCBS

alpha-BHC	4,4'-DDE	alpha-Chlordane
beta-BHC	Endrin	gamma-chlordane
delta-BHC	Endosulfan II	Toxaphene
gamma-BHC (Lindane)	4,4'-DDD	Aroclor-1016
Heptachlor	Endosulfan sulfate	Aroclor-1221
Aldrin	4,4'-DDT	Aroclor-1232
Heptachlor epoxide	Methoxychlor	Aroclor-1242
Endosulfan I	Endrin ketone	Aroclor-1248
Dieldrin	Endrin aldehyde	Aroclor-1254
		Aroclor-1260



PCB Sample Extraction Kit

• Intended Use

For use in conjunction with RaPID Prep™ Soil Collection Kit and the PCB RaPID Assay® Kit for determination of PCB in soil.

• Principle

Before the 1970 regulations of the Toxic Substances Control Act were put in place, polychlorinated biphenyls (PCBs) were produced in the United States for use in a wide variety of industrial applications including electrical transformers and capacitors, paints, inks and pesticides. The chemical and physical stability of these compounds can lead to long term environmental problems. The non-polar structure of this class of compounds imparts a hydrophobicity that allows PCBs to adsorb readily to soil and other solid surfaces. Accurate determination of the PCB content of soils suspected of contamination is necessary to make appropriate decisions regarding site cleanup and remediation.

The reagents contained in the RaPID Prep PCB Sample Extraction Kit have been optimized for fast, efficient removal of PCB from soil and convenient preparation of the sample for immunoassay at levels of interest to the investigator. The system allows for reliable, convenient and cost effective determinations at the field testing or remediation site.

• Description of Contents

1. PCB Extraction Solution
100% methanol with soil dispersion agent.
per kit: 20 bottles containing 25 ml, each
2. PCB Extract Diluent
Buffered saline solution containing preservatives and stabilizers without any detectable PCB.
per kit: 20 vials containing 25 ml, each
3. Twenty five microliter precision pipet.
4. Pipet tips
per kit: 21 disposable plastic tips
5. Chain of custody container labels.
per kit: 30 labels for eluent vials

• Reagent Storage and Stability

Store all reagents and components in a dry well ventilated area at 2-30°C. Reagents may be used until the expiration date shown on the vials.

Consult local, state and federal regulations for proper disposal of all reagents.

• Materials Not Provided

In addition to the materials provided, the following items will be necessary for the performance of the procedure:

- RaPID Prep Soil Collection Kit
- stopwatch or clock with second hand
- permanent marking pen
- protective gloves
- digital balance (optional, available from Chemicon)

• Sample Information

This kit was validated for use with soil samples. Other types of sample matrices and solid wastes may require different procedures to extract PCB.

• Procedural Notes and Precautions

Do not use any reagent beyond its stated shelf life.

Sixty seconds of continuous agitation of the soil sample in the

presence of the extraction solution is important for good extraction efficiency. Use of a one minute timer or stopwatch to assure adequate shaking time is recommended.

Avoid contact of extraction solution (100% methanol) with skin and mucous membranes. If this reagent comes in contact with skin wash with water.

The twenty five microliter pipet is considered disposable and should be discarded after the kit reagents are depleted.

Due to the large dilution factor used, the accuracy of the final result will depend in part on the care taken in pipetting the soil extract into the diluent.

• Limitations

The PCB Sample Extraction Kit, when used in conjunction with RaPID Prep Soil Collection Kit and the PCB RaPID Assay, will provide screening results. Positive results may need to be confirmed by a non-immunological method.

• Extraction/Filtration Procedure

Read the Procedural Notes and Precautions and the RaPID Prep Soil Collection kit package insert before proceeding. Various soil sampling options are presented in the Soil Collection Kit package insert.

1. Write sample information on the labels provided for soil collection device, extract collection vials and PCB Extract Diluent vials. Apply labels to appropriate vessels.

2. **Sampling:** Remove the screw cap from the soil collector and collect soil by volume or by weight as follows:

2.1 **By volume:** With the plunger fully depressed (pushed to the top of the tube), pack soil into the open end of the collection tube. Unscrew the plunger rod from its plunger by turning the handle counterclockwise. Level the soil flush with the top of the collector tube using the plunger rod. Using the base portion of the handle, push the soil sample and the plunger to the bottom.

2.2 **By weight using digital balance:**

Option 1. Remove screw cap. Turn the soil collector with its plunger rod. Collect the soil "By volume," level it off and push the soil and plunger to the bottom of the tube. Reattach plunger rod and weigh the tube containing the soil. Subtract original weight from final weight to determine soil weight. Record the weight of the soil.

Option 2. Remove the screw cap and plunger rod from an empty collection tube. Position the plunger at the bottom of the collection tube. Attach the red base piece provided and place the tube in an upright position on the balance and tare weight. Weigh 10 ± 0.1 gram of soil into the tube. Record the soil weight.

3. Extraction

3.1 Position the soil collection tube containing a soil sample upright in the Styrofoam rack.

3.2 Pour the contents of one vial of PCB Extraction Solution into the collector. Screw the cap (without filter) on tightly and make sure that the luer cap is secured.

3.4 **SHAKE VIGOROUSLY AND CONTINUOUSLY FOR AT LEAST 60 SECONDS.** Additional shaking may be required to break up large or dry soil aggregates.

3.5 Position the collection tube upright in the rack and allow the mixture to settle at least five minutes.

If batch processing is desired, up to 21 soil samples with added

RAPID PREP™ FLOWCHART: PCB SOIL EXTRACTION PROTOCOL

1 SAMPLING

Using the Soil Sample Collection Device from the Soil Collection Kit, collect soil by weight (10 g) or volume as directed (see package insert for discussion).



4a

DILUTION SCHEME

For samples 500 ppb to 10 ppm:
Add 25 μ L of filtered extract to a vial of PCB Extract Diluent (25 mL).
Cap and mix by inverting several times.
Factor = 2000.



2 EXTRACTION

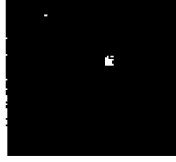
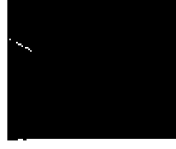
Add 20 mL (entire contents) of PCB Extraction Solution to the Collection Device.
Replace cap (without filter).
Shake for 1 minute.
Let stand for 5 minutes.



4b

DILUTION SCHEME

For samples 50 ppm to 1000 ppm:
Add 25 μ L of filtered extract to a vial of PCB Extract Diluent (25 mL).
Mix.
Add 25 μ L of diluted extract (from 1st dilution) to 2.5 mL of PCB RaPID Assay Diluent.
Mix thoroughly.
Factor = 200,000.



3

FILTRATION

Remove screw cap and attach Filter Cap. Attach plunger rod to device.
Remove filter cap and filter extract into Extract Collection Vial.



5

ASSAY

Analyze diluted extract as "sample" according to the PCB RaPID Assay procedure (see reverse).

Multiply results of extracted soil samples by appropriate factor.

For Ordering or Technical Assistance Contact:
Ohmicron Environmental Diagnostics, Inc.
800 544-8881 215 860-5115
FAX 215 860-5213

PCB Rapid Assay Kits
Part # A00133 30 Tests
A00134 100 Tests
RaPID Prep Soil Collection Kit A00127
RaPID Prep PCB Sample Extraction Kit A00137

PCB in Soil

• Intended Use

For detection of Polychlorinated Biphenyls (PCBs) in soil.

• Materials Required but Not Provided

RaPID Prep™ Soil Collection Kit and PCB Sample Extraction Kit.

• Procedural Notes and Precautions

Prepare soil samples for analysis according to the procedure given in the PCB Sample Extraction Kit. Then, follow the immunoassay procedure as described in the PCB RaPID Assay® Kit package insert.

As with all immunoassays, a consistent technique is the key to optimal performance. To obtain the greatest precision, be sure to treat each tube in an identical manner.

Add reagents directly to the bottom of the tube while avoiding contact between the reagents and the pipet tip. This will help ensure consistent quantities of reagent in the test mixture.

Avoid cross-contamination and carryover of reagents by using clean pipets for each sample addition and by avoiding contact between reagent droplets on the tubes and pipet tips.

• Quality Control

A control solution at approximately 3 ppb of PCB (see Aroclor 1254) is provided with the PCB RaPID Assay kit. It is recommended that it be included in every run and treated in the same manner as unknown samples. Once the control results are corrected for the dilution factors (see Results section) an acceptable result should be 2000 times the value stated on the vial, i.e. 6.0 \pm 1.2 ppm.

• Results

Multiply the sample and control results by the appropriate dilution factor introduced by the collection, extraction and extract dilution steps. When the collection/extraction/dilution procedure described in the PCB Sample Extraction Kit is performed with a ten gram soil sample, the RaPID Assay result is multiplied by 2000 to determine the soil PCB concentration. Alternatively, program the RPA-1 Analyzer as listed below to automatically correct for this dilution factor.

Using the RPA-1™ RaPID Analyzer, calibration curves can be automatically calculated and stored. Refer to the RPA-1 operating manual for detailed instructions. To obtain results from the PCB RaPID Assay on the RPA-1 the following parameter settings are recommended:

Date Recdct : Lin. Regression
Xformation : Ln/Log10
Read Mode : Absorbance
Wavelength : 450 nm
Units : PPM
Rpt Bk : 0

Calibrators:
of Cal : 4
of Rpts : 2

Concentrations:
#1: 0.00 PPM
#2: 0.50 PPM
#3: 2.00 PPM
#4: 10.00 PPM

Range : 0.20 - 10.00
Correlation : 0.990
Rep. %CV : 10%

• Expected Results

In a study with 16 samples including both field contaminated soils and analytically spiked soils samples, the RaPID Prep PCB Sample Extraction Kit results were shown to correlate well with a gas chromatographic method ($r = 0.905$).

• Performance Data

Range of Detection

The PCB RaPID Assay has a range of detection in soil of 500 ppb to 10 ppm when used in conjunction with the PCB Sample Extraction Kit.

Accuracy

PCB recoveries will vary depending on soil type, retention mechanism, solvent and extraction apparatus used, length of extraction period and levels of potentially interfering substances in the soil.

Two (2) soils of the clay and loam type were fortified with PCB (Aroclor 1254) to final soil concentrations of 0.50 and 500 ppm. Average recovery of added PCB was 85%. Results ranged from 74 to 101%.

Precision

The overall coefficient of variation (%CV) for PCB measurement in soil spiked at 4 ppm using the RaPID Prep components and PCB RaPID Assay is less than 20%. This represents the amount of variability expected when a homogeneous soil sample undergoes ten replicate collections, extractions and dilutions generating ten immunoassay results from a single run.

Method	Sample Collection	
	by weight	by volume
# of replicates	10	10
mean results (ppm)	3.20	3.47
% CV	15.2	18.3

• Assistance

For ordering or technical assistance contact:
Chemicron Environmental Diagnostics
Sales Department
Newtown, Pennsylvania 18940
(610)544-8861 • Fax(215)880-5213

• Availability

Chemicron
PCB RaPID Assay
30 Test Kit
100 Test Kit
PCB Sample Diluent
PCB Proficiency Samples
RaPID Prep Soil Collection Kit
RaPID Prep PCB Sample Extraction Kit

200704

9112004

RaPID Assays®

Carcinogenic PAHs Sample Extraction Kit

• Intended Use

For use in conjunction with RaPID Prep™ Soil Collection Kit and the Carcinogenic PAHs RaPID Assay® Kit for determination of Carcinogenic PAHs in soil.

• Principle

Polycyclic aromatic hydrocarbons (PAHs) are a group of compounds composed of two or more fused aromatic rings. The U.S. EPA has identified 16 unsubstituted PAHs as priority pollutants. The seven (7) PAHs that are typically considered to be probable or possible human carcinogens are benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene. Benzo(a)pyrene is the most potent carcinogen among the PAHs. Carcinogenic PAHs are introduced into the environment as a product of natural and fossil fuel combustion. As a source of environmental contamination, PAHs are a serious problem at manufactured gas plants (MGP), coking operations, wood preserving sites that use creosote as a preservative and petrochemical waste disposal sites. The large number of these sites which are contaminated by carcinogenic PAHs in soil and groundwater has led federal and state agencies to mandate their clean-up. These agencies have set various regulatory levels for carcinogenic PAHs in soil, however the usual concentrations of interest are less than 1 ppm. Accurate determination of the carcinogenic PAH content of contaminated soils is necessary to make appropriate decisions regarding site cleanup and remediation.

The reagents contained in the RaPID Prep Carcinogenic PAHs Sample Extraction Kit have been optimized for fast, efficient removal of Carcinogenic PAHs from soil and convenient preparation of the sample for immunoassay at levels of interest to the investigator. The system allows for reliable, convenient and cost effective determinations at the field testing or remediation site.

• Description of Contents

1. Carcinogenic PAHs Extraction Solution
Methanol with soil dispersion agent,
per kit: 20 bottles containing 20 mL each
2. Carcinogenic PAHs Extract Diluent
Buffered saline solution containing preservatives and stabilizers
without any detectable Carcinogenic PAHs,
per kit: 20 vials containing 0.5 mL each
3. Chain of custody container labels,
per kit: 38 labels for diluent vials

• Reagent Storage and Stability

Store all reagents and components in a dry well ventilated area at 2-30°C. Reagents may be used until the expiration date shown on the vials.

Consult local, state and federal regulations for proper disposal of all reagents.

• Materials Not Provided

In addition to the materials provided, the following items will be necessary for the performance of the procedure:

- RaPID Prep Soil Collection Kit
- stopwatch or clock with second hand
- permanent marking pen
- protective gloves
- digital balance (optional, available from GDO)
- precision pipet and tips capable of delivering 200 µL

• Sample Information

This kit was validated for use with soil samples. Other types of sample matrices and solid wastes may require different procedures to extract Carcinogenic PAHs.

• Procedural Notes and Precautions

Do not use any reagent beyond its stated shelf life.

Sixty seconds of continuous agitation of the soil sample in the presence of the extraction solution is important for good extraction efficiency. Use of a one minute timer or stopwatch to assure adequate shaking time is recommended.

Avoid contact of extraction solution (methanol) with skin and mucous membranes. If this reagent comes in contact with skin wash with water.

Due to the large dilution factor used, the accuracy of the final result will depend in part on the care taken in plating the soil extract into the diluent.

• Limitations

The Carcinogenic PAHs Sample Extraction Kit, when used in conjunction with RaPID Prep Soil Collection Kit and the Carcinogenic PAHs RaPID Assay, will provide screening results. Positive results may need to be confirmed by a non-immunological method.

• Extraction/Filtration Procedure

Read the Procedural Notes and Precautions and the RaPID Prep Soil Collection Kit package insert before proceeding. Various soil sampling options are presented in the Soil Collection Kit package insert.

1. Write sample information on the labels provided for soil collection device, extract collection vials and Carcinogenic PAHs Extract Diluent vials. Apply labels to appropriate vessels.

2. **Sampling:** Remove the screw cap from the soil collector and collect soil by volume or by weight as follows:

2.1 **By volume:** With the plunger fully depressed (pushed to the top of the tube), pack soil into the open end of the collection tube. Unscrew the plunger rod from its plunger by turning the handle counterclockwise. Level the soil flush with the top of the collector tube using the plunger rod. Using the base portion of the handle, push the soil sample and the plunger to the bottom.

2.2 **By weight using digital balance:**

Option 1. Remove screw cap. Turn the soil collector with its plunger rod. Collect the soil "By volume," level it off and push the soil and plunger to the bottom of the tube. Reattach plunger rod and weigh the tube containing the soil. Subtract original weight from final weight to determine soil weight. Record the weight of the soil.

Option 2. Remove the screw cap and plunger rod from an empty collection tube. Position the plunger at the bottom of the collection tube. Attach the red base piece provided and place the tube in an upright position on the balance and tare weight. Weigh 10 ± 0.1 gram of soil into the tube. Record the soil weight.

3. Extraction

3.1 Position the soil collection tube containing a soil sample upright in the Styrofoam rack.

3.2 Pour the contents of one vial of Carcinogenic PAH Extraction Solution into the collector. Screw the cap (without filter) on tightly and make sure that the bar cap is secured.



The Quality Difference

RaPID Assays

Carcinogenic PAHs in Soil

• Intended Use

For detection of Carcinogenic Polynuclear Aromatic Hydrocarbons (cPAHs) in soil.

• Materials Required but Not Provided

RaPID Prep™ Soil Collection Kit and Carcinogenic PAHs Sample Extraction Kit.

• Procedural Notes and Precautions

Prepare soil samples for analysis according to the procedure given in the Carcinogenic PAHs Sample Extraction Kit, then, follow the immunoassay procedure as described in the Carcinogenic PAHs RaPID Assay® Kit package insert.

As with all immunoassays, a consistent technique is the key to optimal performance. To obtain the greatest precision, be sure to treat each tube in an identical manner.

Add reagents directly to the bottom of the tube while avoiding contact between the reagents and the pipet tip. This will help assure consistent quantities of reagent in the test mixture.

Avoid cross-contamination and carryover of reagents by using clean pipets for each sample addition and by avoiding contact between reagent droplets on the tubes and pipet tips.

• Quality Control

A control solution of approximately 2.0 ppb of Carcinogenic PAH (as benzo(a)pyrene) is provided with the Carcinogenic PAHs RaPID Assay kit. It is recommended that it be included in every run and treated in the same manner as unknown samples. Once the control results are corrected for the dilution factors (see Results section) an acceptable result should be 100 times the value stated on the vial; i.e. 200 ± 40 ppb.

• Results

Multiply the sample and control results by the appropriate dilution factor introduced by the collection, extraction and extract dilution steps. When the collection/extraction/dilution procedure described in the Carcinogenic PAHs Sample Extraction Kit is performed with a ten gram soil sample, the RaPID Assay result is multiplied by 100 to determine the soil Carcinogenic PAH concentration. Alternatively, program the RPA-1 Analyzer as listed below to automatically correct for this dilution factor.

Using the RPA-1™ RaPID Analyzer, calibration curves can be automatically calculated and stored. Refer to the RPA-1 operating manual for detailed instructions. To obtain results from the Carcinogenic PAHs RaPID Assay on the RPA-1 the following parameter settings are recommended:

Data Reduct : Lin. Regression
Xformation : Ln/Log10
Read Mode : Absorbance
Wavelength : 450 nm
Units : PPB
Rpt Bk : 0

Calibrators:
of Cal : 4
of Rpts : 2

Concentrations:
#1: 0.00 PPB
#2: 10.0 PPB
#3: 100.0 PPB
#4: 500.0 PPB

Range : 4 - 500
Correlation : 0.990
Rep. %CV : 10%

• Expected Results

In a study with 23 field contaminated soil samples, The Carcinogenic PAHs RaPID Assay was shown to correlate well against EPA Method 8270 (GC/MS). Using a cutoff of 0.7 ppm for the immunoassay, less than 5% false positives and no false negatives were observed when compared to a 1.0 ppm action limit for the reference method.

• Performance Data

Range of Detection

The Carcinogenic PAHs RaPID Assay has a range of detection in soil of 10 ppb to 500 ppb of benzo(a)pyrene, when used in conjunction with the Carcinogenic PAHs Sample Extraction Kit.

Recovery

Carcinogenic PAH recoveries will vary depending on soil type, retention mechanism, solvent and extraction apparatus used, length of extraction period and levels of potentially interfering substances in the soil.

Thirteen (13) soils of various types were fortified with Carcinogenic PAHs (Benzo(a)pyrene) to final soil concentrations of 100 ppb. All soils were then subjected to the above extraction/dilution procedure. Average recovery of the added PAHs was 98%. Results ranged from 76 to 132%.

Precision

The overall coefficient of variation (% CV) for Carcinogenic PAH measurement in soil spiked at 100 ppb using the RaPID Prep components and Carcinogenic PAHs RaPID Assay is less than 10%. This represents the amount of variability expected when a homogeneous soil sample undergoes ten replicate collections, extractions and dilutions generating ten immunoassay results from a single run.

Method	Sample Collection	
	by weight	by volume
# of replicates	10	10
mean results (ppm)	83.1	83.9
% CV	5.8	6.6

• Assistance

For ordering or technical assistance contact:
Obmicron Environmental Diagnostics
Sales Department
Newtown, Pennsylvania 18840
(800)544-8881 • Fax (215)860-5213

• Availability

Obmicron
Carcinogenic PAHs RaPID Assay
30 Test Kit
100 Test Kit
Carcinogenic PAHs Sample Diluent
Carcinogenic PAHs Proficiency Samples
RaPID Prep Soil Collection Kit
RaPID Prep Carcinogenic PAHs Sample Extraction Kit

RAPID PREP™ FLOWCHART: PAH'S SOIL EXTRACTION PROTOCOL

1 SAMPLING

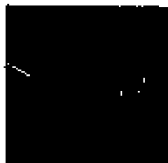
Using the Sor® Sample Collection Device from the Soil Collection Kit, collect soil by weight (10 g) or volume as directed (see package insert for discussion).



4a

DILUTION SCHEME

For samples 200 ppb to 5 ppm:
Add 250 µL of filtered extract to a vial of PAH's Extract Diluent (12.25 mL).
Cap and mix by inverting several times.
Factor = 100.



2 EXTRACTION

Add 20 mL (entire contents) of PAH's Extraction Solution to the Collection Device.
Replace cap (without filter).
Shake for 1 minute.
Let stand for 5 minutes.



4b

DILUTION SCHEME

For samples 2 ppm to 50 ppm: (see Environmental User's Guide)
Add 250 µL of filtered extract to a vial of PAH's Extract Diluent (12.25 mL).
Mix.
Add 250 µL of diluted extract (from 1st dilution) to 2.25 mL of PAH's RaPID Assay Diluent.
Mix thoroughly.
Factor = 1,000.



3

FILTRATION

Remove screw cap and attach Filter Cap. Attach plunger rod to device.
Remove luer cap and filter extract into Extract Collection Vial.



5

ASSAY

Analyze diluted extract as "sample" according to the PAH's RaPID Assay procedure (see reverse).
Multiply results of extracted soil samples by appropriate factor.

For Ordering or Technical Assistance Contact:
Ohmicron Environmental Diagnostics, Inc.
800 544-8881 215 860-5115
FAX 215 860-5213

Part # A00156 30 Tests
A00157 100 Tests
RaPID Prep Soil Collection Kit A00127
RaPID Prep PAH's Sample Extraction Kit A00160

STANDARD OPERATING PROCEDURE

IN-SITU FIELD SCREENING OF METALS IN SOIL BY RADIOISOTOPE EXCITED X-RAY FLUORESCENCE SPECTROMETRY



**DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENTAL CONTROL
DIVISION OF AIR & WASTE MANAGEMENT
SITE INVESTIGATION & RESTORATION BRANCH
NOVEMBER, 1996**

STANDARD OPERATING PROCEDURE

In-Situ Field Screening of Metals in Soil by Radioisotope Excited X-ray Fluorescence Spectrometry

I. Scope and Application

1. This method discusses the application of the bench top Quanx for screening of metals in soil. The data generated on the Quanx allow rapid evaluation of the extent of contamination for the purpose of site characterization and remediation.
2. The method will also address data integrity by discussing resolution, measurement precision, accuracy, and the need for occasional sample preparation for exceptionally moist or coarse soil.
3. The elements quantitated in the main soil application on-board the analyzer are: Ca, Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se Hg, Pb, Ag, Cd, Sb, Ba. Any element heavier than phosphorus can be substituted into this list.
4. For the Quanx, the method is applicable to hazardous waste site characterization and screening for the metals and detection limits listed in Appendix A. These detection limits are calculated from each element analyzed in a clean Silicate matrix for 200 second count time.
5. Refer to the Quanx manual for instrument hardware information, software menu schematic, instrument specifications, source and battery replacement, etc.
6. This procedure may involve hazardous materials, operations, and equipment. All of the safety concerns associated with the use of this method will not be addressed. The operator should refer to the Quanx manual and pertinent OSHA guidelines for proper equipment and soil handling procedures.

II. Method Summary

1. The principle of X-ray fluorescence analysis is based on atomic excitation. Elements in a soil sample are irradiated with a beam of X-rays. Inner-orbital electrons in the atom are photoejected and leave the atom in an excited state as a result of electron vacancy. Relaxation of the atom occurs when an outer orbital electron fills the vacancy and results in emission of X-rays possessing energy unique to each element in the sample.
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2. For in situ soil measurements, the analyzer probe is simply placed directly on the soil surface. Each of the three radioactive sources are rotated into position irradiating the soil for an amount of time that has been determined to adequately measure the elements of interest in the soil. The mercuric iodide detector is simultaneously processing emitted characteristic X-rays from the elements in the soil. Intensities extracted from the individual X-ray spectra are applied to an iterative calculation using coefficients derived from fundamental parameters. The operator is presented with element concentrations in parts per million (ppm) with theoretical standard deviations.

III. Interferences

1. Moist conditions can cause soil to adhere to the probe face window. To avoid contamination of subsequent measurements, periodically check the window for macroscopic soil particles. In most cases a dry cloth can be used to wipe the probe face and window clean.
2. The coarseness (or particle size), moisture content, and degree of homogeneity of the soil can interfere with the accuracy and/or precision of a measurement. In the case of in-situ soil analyses, best results are obtained on reasonably dry, flat, compacted surfaces of fine-grained soils. Good results can be obtained at moisture contents up to about 25%, beyond this point the soil is wet mud and must be contained in a sample cup.
3. Overlapping element emission lines in the spectrum can be a source of interference in some cases. An example of this is the overlap of lead L-lines with arsenic K-lines. Samples with exceptionally high lead concentrations elevates the detection limit of arsenic in the soil.

IV. Apparatus and Materials

1. Quanx X-ray fluorescence spectrometer is equipped with three electrically coded detectors.
 2. A trowel for smoothing and compacting soil
 3. Soil jars or strong plastic bags for taking samples
 4. Drying dish for moist soil can be either glass, Teflon or disposable polypropylene
 5. Vented microwave oven
 6. Grinding device for homogenizing dried soils. Mortar and pestle or tungsten carbide grinding vessels.
 7. Plastic sample cups - 32 mm.
-

8. X-ray film - 6.3 um polypropylene X-ray window film.

V. Fundamental Parameters Instrument Calibration

As mentioned in the method summary, measured analyte intensities are used to calculate element concentrations using a fundamental parameters (FP) algorithm of the form:

$$\text{Concentration} = R \times S \times (1 + \text{SUM} [A_n \times C_n])$$

where, R = the measured analyte X-ray intensity relative to the pure element intensity

S = a calculated sensitivity coefficient.

AN = the alpha coefficient describing the effect of matrix element "n" on the element being calculated

CN = the concentration of the matrix element "n"

The quantity $\text{SUM}[A_n \times C_n]$ is a summation of "n" element absorption-enhancement terms containing fundamental parameters determined alpha-coefficients for the purpose of iteratively composing element concentrations. The summation term allows the instrument to be sensitive to any matrix variations within the soil, therefore eliminating the need for site specific standards. The menu-driven software in the Quanx supports multiple XRF calibrations called "Applications." Each Application is a complete analysis configuration including elements to be measured, interfering elements in the sample, and a set of FP calibration coefficients. The pure element intensities, sensitivity and alpha coefficient are all installed during manufacturing so the instrument does not need calibration.

VI. Instrument Operation Check

1. Energy calibration operations are available on the analyzer. Energy calibration is a menu prompted operation executed by the user that involves placing the safety cover on the probe and initiating the ENERGY CALIBRATION function. This energy calibration utilizes the lead X-rays generated while irradiating the lead-lined safety cover. The automatic energy calibration can be relied upon in cases where the instrument is being used daily. The safety cover energy calibration should be used after the instrument has been out of use for several days and the battery has been unplugged.
2. To document the instrument is operating within resolution and stability tolerances, the standard operational check should be run before each day of field work. This is done by placing the pure element iron provided with the instrument over the window and running a 50 second analysis for each source. This should only be run with the probe in the lab stand base using the sample safety cover. Once this is complete, proceed by viewing the raw relative intensities for iron, manganese and cobalt. A relative intensity greater than 0.950 for iron and

less than 0.006 for manganese and cobalt indicates that the system is working properly. Each day's relative intensities should be written down in a log book for reference and documentation.

VII. Data Quality Assurance and Control

1. If contamination of the probe window is suspected, a blank should be run to verify the system has been completely decontaminated. If a blank soil is not available, the Teflon plug provided with the instrument can be used for this operation. The lab stand base and sample safety cover with sample positioning ring should be used here to ensure safe operation. The same count times used for field work should be used acquiring blank data. Before running the blank, it is important to DISABLE THE DISPLAY THRESHOLDS to show not detected elements on the results screen and also SHOW STD DEVIATIONS for observation. After running the blank, observe the results for the elements of interest. The magnitude of the resulting ppm concentrations should be no greater than three times the standard deviation value above or below zero. The reported values of the elements of interest and their standard deviations should be logged into a notebook for reference.
2. Since there is no sample preparation error in the in-situ measurement, but only sample presentation error, duplicates will not be run. However, reproducibility (precision) of a measurement will be studied in Section VIII of this method.
3. A check sample should be run every 20 samples to document the stability and consistency of the analysis for the element(s) of interest. The check sample should ideally be a soil from the site that is near the action level and represents the particle size and degree of homogeneity of the unknowns. The check sample can be contained in an X-ray sample cup for running in the lab stand base and should be run with the same count time as the unknowns. These values should be logged into a notebook to alert any significant trend in the analytical measurement. An average, standard deviation and percent relative standard deviation (%RSD) should be calculated from each days results. The quality of the results of the check sample should be gauged by the guidelines provided in Section VIII on precision.

VIII. Procedure

In-situ

1. The in-situ measurement can be taken by simply placing a probe on a flat area of fine grained soil. Any rocks, vegetation or large objects should be cleared from the area to get best results. Also, the immediate area to be measured should be flattened using a trowel (or the bottom of a shoe works well). Note that it is important that the probe be positioned flat against the soil. As much as a sixteenth of an inch of airspace between the aperture window
-

and the soil can disturb a measurement. The area underneath the probe face should not be concave. A flat or slightly convex area provides best results. The analysis is initiated by pushing the trigger button on the probe. The purpose of the DNREC, Bench top is more accurate and precise.

Note: After an analysis, the instrument will display the results screen. From this screen, the results can be stored by pressing STORE to display the labeling screen. The AUTOSTORE option can be employed when all analyses are to be saved. This automatically displays the labeling screen after a measurement and will avoid accidentally not storing a measurement.

Sample preparation and bench top analysis

Note: Although the fundamental parameters software automatically corrects for any element matrix variations in the soil, factors that are not accounted for include soil heterogeneity, particle size and moisture content. These are the three factors that may require that a soil sample be taken and prepared before analysis. In those cases, the sample can be prepared with the following procedure and analyzed with the probe in the lab stand base.

1. Place approximately 5 grams of soil into a drying dish. Remove any large pieces of organic material, rocks or metal.
2. Dry the soil in a microwave on 100% power for 3-5 minutes or in an oven at approximately 100° C until dry. Dry overnight if needed.
3. Grind the soil with a properly decontaminated mortar and pestle or mechanical grinder until desired homogeneity is obtained.
4. Put the soil into a sample cup, seal with 6.3 µm polypropylene X-ray film and analyze.

X. Error Analysis

There are two main contributions to the error of an in-situ X-ray fluorescence measurement: the error due to instrument error and that due to sample inhomogeneity.

Instrument error is presented to operators after each measurement to provide the standard deviation based on theoretical counting statistics. The value of one standard deviation, displayed with the results output, means that 68% of repeat measurements of a homogeneous sample will fall within this error. Two times the standard deviation gives 95% confidence, while 3x provides greater than 99% confidence. As discussed in Section VIII (Precision), error can be reduced by increasing the count time. However, the displayed standard deviation error does not include errors due to uneven distribution of contaminants within the soil.

The error due to soil inhomogeneity is usually the most significant and least predictable. Since the penetrating and escape depth of X-rays in soil is relatively small, inhomogeneous distribution of contaminants on the soil particles can degrade the accuracy and/or precision of a measurement. Exceptionally large particle size soil will contain airspace which represents sample inhomogeneity as it is presented to the probe aperture window. For these reasons, it is important that the degree of soil homogeneity be studied for the site by taking a few samples back to the laboratory, drying and grinding them, placing the soil in a sample cup, analyzing them on the instrument in the lab stand configuration, then comparing the results with the in-situ measurements. If the results vary consistently high or low, then sampling the site and drying and grinding each sample should be considered.

Possible errors from the in-situ measurement:

$$^{O2}_{Tot} = ^{O2}_{inst.} + ^{O2}_{hetero} + ^{O2}_{size} + ^{O2}_{moist}$$

Possible errors from sample preparation method:

$^{O2}_{Tot} = ^{O2}_{inst.} + ^{O2}_{prep}$, where heterogeneity, particle size and moisture problems are virtually eliminated and replaced by a sample preparation term. However, with careful sample preparation the magnitude of those three terms can be determined.

X. Effect of Counting Time on Precision and Detection Limit

Precision

Determine the precision that can be expected by making repeat measurements of a sample at or near the action level or level of concern established at the site. This sample can be the same as the check sample described in the QA/QC section, so it will be run every 20 samples. The precision objective should be $\pm 20\%$ relative standard deviation (%RSD).

Since X-ray emission is an example of a random event, the precision of intensity measurements is theoretically predicted and translated to a ppm value. One standard deviation of the counts used in quantitating a measurement (peak) is represented as the square root of those counts. This is the value that is displayed as the error on the analyzer. Again, this is theoretically based on the counting statistics only and doesn't include any error due to sample inhomogeneity, moisture, contamination, etc.

$$SDEV = \sqrt{N_i} \qquad \%RSD = \frac{\sqrt{N_i}}{N_i} \times 100\% = \frac{100}{\sqrt{N_i}}$$

where, N_i = the number of counts in the peak
 %RSD = the percent relative standard deviation

So, the precision or reproducibility of a measurement will get better with increasing count time. However, increasing the count time by a factor of 4 will get 2X better precision. So a point of diminishing returns is reached.

Example:	Count time	10 sec	Std Dev	+50	ppm
		40 sec		+25	ppm
		160 sec		+12.5	ppm
TRADE-OFF					

Lower Limit of Detection Calculation

As discussed in the section on precision, increasing the count time will decrease the uncertainty of a sample measurement. Decreasing the uncertainty also decreases the detection limit. The magnitude of this improvement is illustrated in the table below:

<u>Element</u>	<u>Count time</u>	<u>LLD</u>	<u>Count Time</u>	<u>LLD</u>
Chromium	200 sec	180 ppm	600 sec	103 ppm
Lead	200 sec	14 ppm	600 sec	8 ppm
Arsenic	200 sec	25 ppm	600 sec	14 ppm

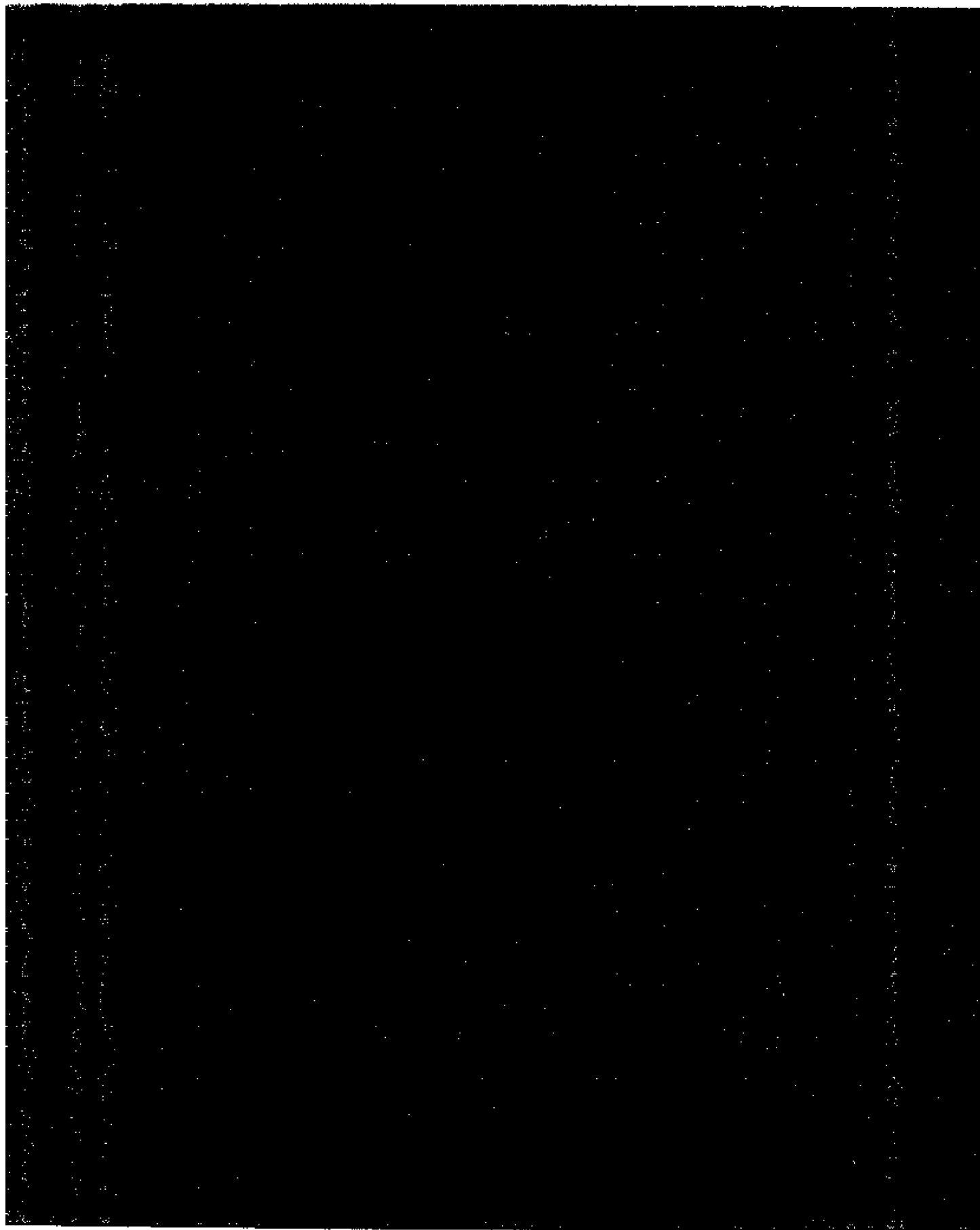
The detectability of an element at a specific count time can be determined by evaluating the reported standard deviation. the validity of data near the LLD can be judged by analyzing a soil just above the detection limit. If the result is greater than 10 standard deviations the element is definitely present in the sample and can be accepted as a quantitative measure of it's concentration. A result below 3 standard deviations is, by definition, below the detection limit of the instrument. Results between 3 and 10 standard deviations fall into a gray area. If possible, increase the count time by a factor of four and rerun the sample.

Appendix A

Lower Limits of Detection for the Quanx [3 SD (BKG)]

Element	MDL (ppm)
Ca	178
Tl	4.4
Cr	17.4
Mn	20.4
Fe	82
Co	313
Ni	23.8
Cu	8.6
Zn	8.7
As	2.7
Se	3.0
Hg	6.5
Pb	2.7
Cd	1.7
Sb	19.8
Ba	11.7

RMS:sfh:dmg
rms96055.doc



**GEORGE GRAY ELEMENTARY SCHOOL
BROWNFIELDS PRELIMINARY ASSESSMENT II**

Test Pit Descriptions

TEST PIT	LOCATION	DESCRIPTION
GGTP-1	W. end of asphalt parking lot, 40' from building	0-12" 2" asphalt, mixed orange-brown clay w/ some sand & red clay, some small stones (round) & whole brick, some gray-green clay-sand, large quartz rock, (fill) 1-2' Orange & red clay w/ some orange & gray/white sand 2-3' Orange & some gray sand w/ some silt, damp 3-5' Same, some bright red clay 5-6' Red clay, stiff w/ some orange-gray clay & sand 6-7' Same, more gray clay 7-8' Red clay 8-9' Red clay, some sand lenses 9-10' Red clay 10-11' Red clay w/ orange/brown silty clay w/ some gray clay 11-12' Orange/brown silty clay 12-13' Orange/brown & gray silty clay (sapprolite)
GGTP-2	Center of S. asphalt parking lot	0-12" 2" asphalt, orange-brown sandy clay & silt, some red-gray clay, some stones, glass frags, metal & brick pieces (fill) 1-2' Lt. to drk. Brown clayey silt w/ gray clay w/ much bright orange silty clay (some sand) 2-4' Bright orange clayed silt w/ some sand 4-6' Same w/ some lt. gray silt clay 6-7' Same, @7' Red clay (stiff) 7-8' Red clay w/ some gray clay, variegated 8-9' Same, w/ white sand stringers 9-10' Same, w/ gray sand/sapprolite @10'
GGTP-3	W. side of UST area, E. end of parking lot	0-12" 2" asphalt, crusher run stone & large rock (angular), drk. brown-gray clay fill 1-2' Dark brown-gray clay silt 2-3' Dark brown & gray silty clay 3-4' Lt. brown to orange sandy silt & clay 4-5' Lt. brown to orange silty clay, some sand 5-6' Dark brown to orange-red clay, some sand 6-11' Same, orange-red 11-12' Same, to gray-white med. to coarse grained sand w/ remnant structures, fine grained black oxidized material, pink feldspar, moist

**GEORGE GRAY ELEMENTARY SCHOOL
BROWNFIELDS PRELIMINARY ASSESSMENT II**

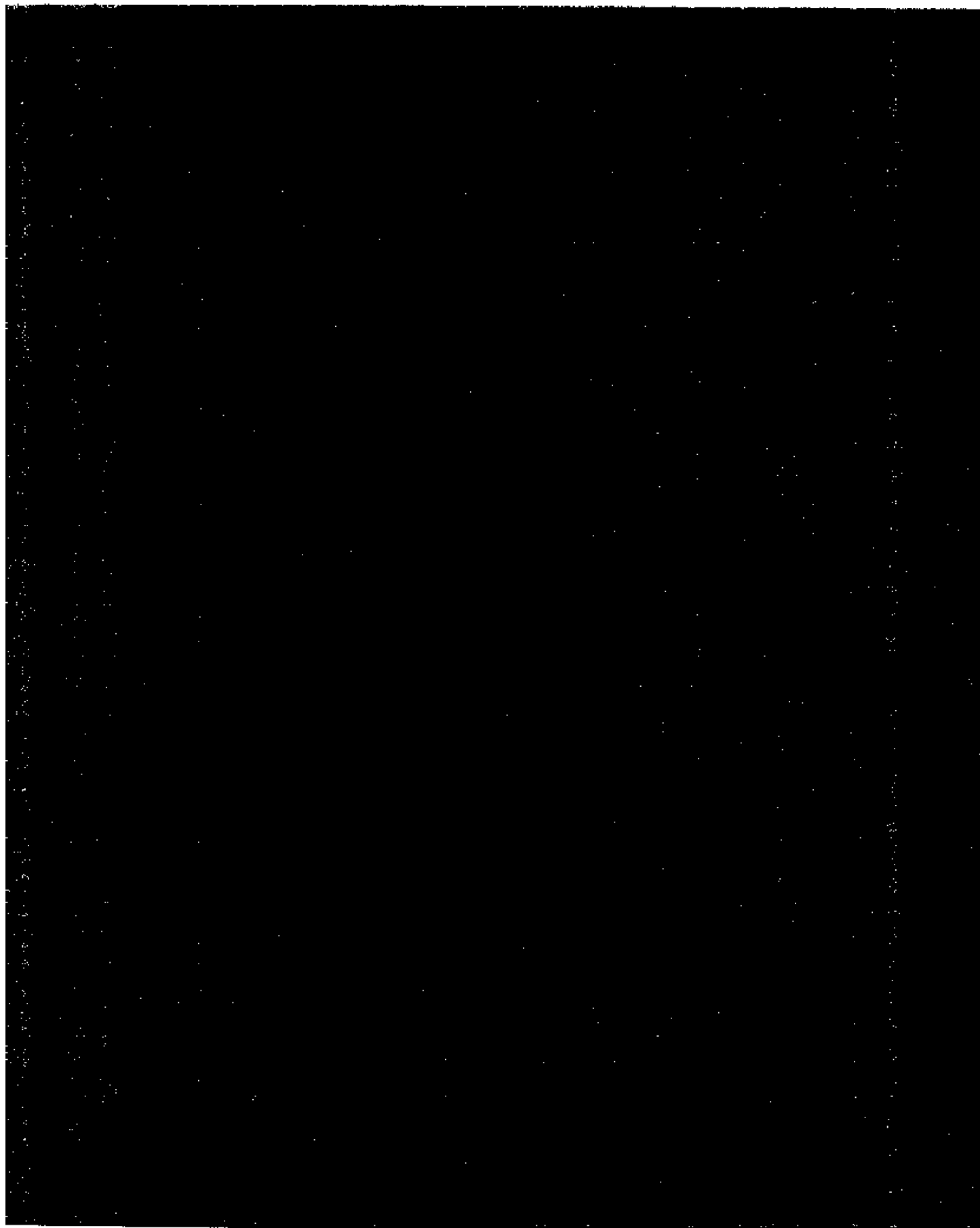
Test Pit Descriptions

GGTP-4	S. side of UST area, E. end of S. parking lot	<p>0-12" 2" asphalt over dark brown sand & bright orange clay</p> <p>1-2' Dark brown & orange silty clay w/ layer of coal/incinerator ash</p> <p>2-3' Gray & black coal & incinerator ash, 18" band @ 2'</p> <p>3-4' Dark brown sandy silt w/ some ash</p> <p>4-6' Dark brown loamy silt</p> <p>6-7' Brown, orange & red clay</p> <p>7-10' Bright red clay, stiff, dry</p> <p>10-11' Same, w/ some saprolite</p> <p>11-12' Same, saprolite, very hard</p> <p>12-13' more saprolite, wet, water @ 13'</p>
GGTP-5	E. side of UST area, E. end of S. parking lot	<p>0-12" Broken asphalt & grass, black loam, dark brown sandy silt (dry) w/ stones, metal, wood, glass</p> <p>1-4' Dark brown silty clay</p> <p>4-6' Same w/ sand and rounded stones 1" dia., some larger stones, quartz</p> <p>6-7' Layer of coal ash & coal</p> <p>7-9' Lt. to dark brown & orange clay</p> <p>9-10' Same, more sand</p> <p>10-11' Gray-green silty sand w/ large round cobbles, very wet, water @ 11.5'</p>
GGTP-6	10' E. of playground pavement area	<p>0-12" Grass over lt. to dark brown silt & sand w/ brick & rock</p> <p>1-2' Dark brown silt & sand w/ much large rock & brick demo debris</p> <p>2-5' Same, much small rock & stones</p> <p>5-6' Same, dark brown silt & clay, small stones</p> <p>6-8' Dark brown & orange disturbed clays w/ some silt, wetter</p> <p>8-11' Disturbed orange & dark gray clays, some sand</p> <p>11-13' Same, pocket of ash material</p> <p>13-14' Dark gray clay - silt (marsh deposit)</p>
GGTP-7	Grassed field, N. end of property, E. of bldg.	<p>0-12" Grass cover, dark brown silty soil w/ brick pieces</p> <p>1-4' Lt. to dark brown sandy silt</p> <p>4-5' Same, darker brown silty sand & sandy silt, some ash material</p> <p>5-6' Same, more coarse sand</p> <p>6-7' Dark brown & orange silty clay</p> <p>7-8' Silty clay, orange & dark brown w/ some sand, coal frags</p> <p>8-10' Dark brown clay & silt w/ wood, much coarse sand & some gravel, wet</p> <p>10-12' Dark gray very sandy silt w/ gravel, some organic material, very wet</p> <p>12-13' Dark gray silty clay, stiff</p>

**GEORGE GRAY ELEMENTARY SCHOOL
BROWNFIELD'S PRELIMINARY ASSESSMENT II**

Test Pit Descriptions

GGTP-8	W. side of grass field, along sidewalk, E. of 1954 section of building	<p>0-12" Grass cover, lt. brown soil w/ large concrete slabs, moved pit 6' closer to bldg</p> <p>1-2' Lt. brown silt clay, a few rounded pebbles</p> <p>2-5' Same, minor brick pieces</p> <p>5-6' Same, more debris, brick, rock, some coal slag, ash, disturbed sapprolite, (bedrock), damp</p> <p>6-11' Same, darker brown silty clay, more wet, sides of pit caving</p> <p>11-12' Layer of gray-green silty sand, very wet</p> <p>12-13' Dark gray clay, stiff</p> <p>13-14' Dark gray silt clay, w/ vegetation, animal bones, rounded stones</p>
GGTP-9	NE corner of grass area	<p>0-12" Grass over dark brown sandy soil 6", dark brown sandy soil w/ much brick, rock, glass, pottery shards, mortar, some ash, coal, slag, metal (fill)</p> <p>1-2' Same as above</p> <p>2-3' Same, much more brick & rock</p> <p>3-4' Same, damp soil, lots of brick & rock</p> <p>4-7' Orange & brown silt clay, ash @ 7'</p> <p>7-8' Gray incinerator ash, w/ much glass bottles, pottery, shoes, wood</p> <p>8-9' Ash, wetter</p> <p>9-10' Ash, wet, rust colored</p> <p>10-11' Ash, very wet, water @ 11'</p> <p>11-12' Ash over dark gray clay, sticky, w/ thin black organic layer</p> <p>12-13' Dark gray clay, sticky</p>
GGTP-10	E. side of grass area, End of 22 nd St., 50' W. of Thatcher St. (area has concrete bases for playground equip.)	<p>0-12" Grass cover, Lt. to dark brown top soil w/ some orange silty sand</p> <p>1-4' Dark brown silty sand w/ large rock, brick, mortar, demo debris, very dry (fill)</p> <p>4-5' Same, damp</p> <p>5-7' Dark brown silty clay w/ some sand, some black material, possibly charcoal</p> <p>7-8' Same, w/ minor ash, coal, slag</p> <p>8-11' Same, w/ more wood, ashlike material, dark gray clay (disturbed), oyster & clay shells, coal pieces, pottery & porcelain pieces</p> <p>11-12' Dark gray clay, medium stiff w/ some dark red clay</p> <p>12-16' Dark gray clay, medium stiff (marsh)</p> <p>16-17' Very dark gray to black clayey silt w/ peat, vegetation</p>
GGTP-11	N. side of bldg., grass area, N. of sidewalk near E. door	<p>0-12" Grass cover over lt. to dark brown silty sand w/ small stones (fill)</p> <p>1-2' Lt. to dark brown silty clay to orange clay w/ much larger stone & round cobbles</p> <p>2-10' Same, w/ brown silty sand</p> <p>10-11' Dark gray to black silty clay w/ small roots (marsh)</p> <p>11-13' Very sticky dark gray silty clay w/ small 1" rounded pebbles, wet, water @ 12.5'</p>



**DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENTAL CONTROL
DIVISION OF AIR & WASTE MANAGEMENT
Site Investigation & Restoration Branch**

MEMORANDUM

Date: March 11, 1999

Subject: George Gray School Soil Inorganic Data Validation

From: Robert M. Schulte *RM/ 3/11/99*
Analytical Chemist

To: Lawrence J. Jones
Project Officer

Through: Karl F. Kalbacher *KFK 3/11/99*
Program Manager

Overview

The Sample Delivery Group (SDG) consisted of ten (10) soil samples, one rinse blank (SW-2), one trip blank (SW-1) and two field duplicate pairs (GGTP15 and GGTP4C, GGTP16 and GGTP9D). The Site Investigation and Restoration Branch (SIRB) of the Delaware Department of Natural Resources and Environmental Control (DNREC) collected the samples. Environmental Services Section of DNREC analyzed the samples according to the Standard Operating Procedures for Chemical Analytical Programs (SOPCAP) under the Hazardous Substance Cleanup Act (HSCA). The samples were analyzed for full TAL inorganics per the chain of custody.

Data Summary

All analytes were successfully analyzed for all samples.

Areas of concern are listed below according to the importance of the issue.

Major Issues

No major issues to report.

Minor Issues

The preparation blank (PB), continuing calibration blank (CCB), initial calibration blank (ICB) and rinse blank had reported results greater than the instrument detection limit (IDL) for the analytes given below. The reported results for these analytes in the affected samples that are less than five times (<5X) the blank concentration may be biased high and do not appear on the data summary forms as detectable valid results. Negative blank values in the blanks

may result in bias low result and all practical quantitation limits must be qualified with a "UJ" as estimated. The following analytes were detected in the blanks: Soil Blank- Aluminum 18.2 mg/Kg, Cadmium .062 mg/Kg, Iron 4.11 mg/Kg, Manganese -.020 mg/Kg, Magnesium 8.12 mg/Kg and Zinc .173 mg/Kg. TCLP Blank-Barium 1.52 ug/L, Cadmium -.251 ug/L, Chromium .689 ug/L, Iron 17.0 ug/L, Magnesium 53.8 ug/L and Mercury -.1 ug/L.

Notes

The laboratory control sample was within validation quality control limits. No qualification is necessary.

All analysis and preparation holding times were within validation quality control limits. No qualification is necessary.

The TAL matrix spike recoveries for Barium, Copper, and Antimony were outside validation quality control limits. All positive results and practical quantitation limits will be qualified "J" and "UJ" as estimated, respectively, on the data summary tables.

All interference check sample results were within validation quality control limits. No qualification is necessary.

The serial dilution results were within validation quality control limits. No qualification is necessary.

All instruments were calibrated daily. No qualification is necessary.

All quantitation and quantitation limits were checked against the raw data. No qualification is necessary.

All data were validated in accordance with the National Functional Guidelines for Evaluating Inorganic Analyses, With Modifications for Use within EPA Region III.

No method of standards addition was performed.

The CRDL standard results are within validation quality control limits. No qualification is necessary.

The instrument detection level study was conducted within validation quality control limits. No qualification is necessary.

TAL Mercury, TCLP Mercury and Zinc laboratory duplicate results were outside of validation quality control limits. All positive results and practical quantitation limits will be qualified "J" and "UJ" as estimated, respectively, on the data summary tables.

All analysis run times were consistent and within validation quality control

limits. No qualification is necessary.

The field duplicate comparison results are as follows:

Concentration mg/Kg

Compound	GGTP-9D	GGTP16D	%RPD
Aluminum	12700	11900	7
Arsenic	18.0	40.8	78*
Calcium	3610	4680	26
Chromium	31.3	56.1	57*
Copper	94.9	343	78*
Iron	44500	80800	58*
Manganese	607	735	19
Mercury	0.79	0.46	53*
Nickel	35.8	104	98*
Selenium	2.9	4.2	37*
Vanadium	41.5	41.3	<1
Zinc	889	1510	52*
Barium	216	194	11
Lead	546	632	15
	GGTP4C	GGTP15	
Aluminum	8630	7780	10
Barium	413	529	25
Calcium	5250	4850	26
Chromium	21.1	21.6	2
Copper	128	124	3
Iron	12300	20700	51*
Lead	709	1450	69*
Mercury	0.46	0.62	30
Nickel	21.0	26.2	23
Selenium	3.2	4.1	25
Vanadium	34.4	39.3	14
Zinc	863	1010	16
Manganese	191	228	18
Arsenic	10.2	12.3	19

* Outside of validation quality control limits

Most field duplicate results are outside validation quality control limits. All positive results and practical quantitation limits will be qualified "J" and "UJ" as estimated, respectively, on the data summary tables .

Attachments:

Data Summary Forms
Results Reported by Laboratory Form IS
Chain of Custody
Support Documentation

RMS.sfb
RMS99019.doc
DE-1138 II A 3

FIELD CHAIN OF CUSTODY



Client: DNRES - SIRS
Address: 391 LUKENS DR
NEW CASTLE DE 19720
Phone: (302) 395-2600

Report To: ROBERT SQUATE
Invoice To: ROBERT SQUATE
Account:
ESS No.:

PROJECT NAME		ANALYSES				REMARKS
SAMPLERS (Signatures)		No. of Containers	BN+LIS	PCST/PCB	TRMS/LCS	
ESS only Lab Log No.	Client Sample Description	Sample Date	Sample Time	Matrix	Comp	Grab
98055900	GGTP-16d	12/2	1205	SO		X
98056000	GGSS-4	12/2	1445	SO		X
98056010	GGSW-1	12/1	1730	SW		X
98056020	GGSW-2	12/2	1515	SW		X
/						
Potential Hazard Identification: Non-Hazard <input type="checkbox"/> Flammable <input checked="" type="checkbox"/> Toxic <input checked="" type="checkbox"/> Skin-Irritant <input checked="" type="checkbox"/> Other <input type="checkbox"/>						
Sample Disposal: Return to Client <input type="checkbox"/> Disposal by ESS <input checked="" type="checkbox"/> Authorized by: <u>[Signature]</u>						
RELINQUISHED BY: (Signature) <u>[Signature]</u>		DATE:	TIME:	RECEIVED BY: (Signature) <u>[Signature]</u>		
		11/3/93	1630			
COMMENTS:		12-7-98	0935	ESS only: <u>[Signature]</u>		

Matrix Codes

AI - air
 BI - biological
 SO - soil
 SW - surface water
 GW - ground water
 SL - sludge
 SD - solid
 DI - oil
 TI - tissue
 WI - wipe
 WW - waste water
 PW - potable water
 SW - surface water
 GW - ground water
 DL - drum liquids
 DS - drum solids
 SW - solid waste
 ST - stormwater
 X - other (Please specify)

ESS USE ONLY

Sample Conditions:

1. Shipped or Hand-delivered: ☒
 2. Cooled or Ambient: ☒
 3. Received broken/sealing: ☒
 4. Properly preserved: ☒
 5. Holding unexpired: ☒
 6. Bottles supplied by ESS: ☒
 7. Field Filtered: ☒
 Notes: ESS only
 Custody Seal: Wash
 1. Present on outer package: ☒
 2. Unbroken on outer package: ☒
 3. Present on sample: ☒
 4. Unbroken on sample: ☒
 5. Discrepancies between sample labels and CQC record? ☒

950216.KAK

White - Original Yellow - ESS Copy Pink - Client Copy

000141

Site Name: George Gray School
 Sampling Date(s): 12/1, 2/98

DATA SUMMARY FORM: INORGANICS

Soils
 (Media) SAMPLES
 (Units) mg/kg

Sample Number	GGTP4C	GGTP1S	GGTP16D	GGTP9D	GGTP1S	GGTP2D	GC.SW2 ug/L
Analyte							
Aluminum	8630	7780	11900	12700	8840	8750	
Antimony							
Arsenic	10.2	12.3	40.8	18.0	8.5		
Barium	413	529	194	216	334	76.1	
Beryllium							
Cadmium							
Calcium	5250	4850	4680	3610	8100	3080	
Chromium	21.1	21.6	56.1	31.3	29.2	15.8	
Cobalt			36.0			16.0	
Copper	128	124	343	94.9	121		
Iron	12,300	20700	80800	44500	17100	36,400	
Lead	709	1450	632	546	1510	211	31
Magnesium						1670	
Manganese	191	228	735	607	210	439	
Mercury	0.46	0.62	0.46	0.79	0.39		
Nickel	210	26.2	104	35.8	267	26.0	
Potassium	1640						
Selenium	3.2	4.1	4.2	2.9	2.1		
Silver							
Sodium							5260
Thallium							
Vanadium	34.4	39.3	41.3	41.5	43.0	36.2	
Zinc	863	1010	1510	989	341	18.7	
Cyanide		0.76					

ENVIROFORMS/INORGANIC CLP

000008

SAMPLE NO.

1
INORGANIC ANALYSIS DATA SHEET

GGTP4c

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #06960

Matrix (soil/water): SOIL

Lab Sample ID: 98055920

Level (low/med): LOW

Date Received: 12/04/98

% Solids: 69.5

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	8630			P
7440-36-0	Antimony	0.95	U	N	P
7440-38-2	Arsenic	10.2			P
7440-39-3	Barium	413		N	P
7440-41-7	Beryllium	0.78	B		P
7440-43-9	Cadmium	0.25	B		P
7440-70-2	Calcium	5250			P
7440-47-3	Chromium	21.1			P
7440-48-4	Cobalt	8.4	B		P
7440-50-8	Copper	128		N	P
7439-89-6	Iron	12300			P
7439-92-1	Lead	709			P
7439-95-4	Magnesium	683	B		P
7439-96-5	Manganese	191			P
7439-97-6	Mercury	0.46		*	CV
7440-02-0	Nickel	21.0			P
7440-09-7	Potassium	1640			P
7782-49-2	Selenium	3.2			P
7440-22-4	Silver	0.43	U		P
7440-23-5	Sodium	727	B		P
7440-28-0	Thallium	1.1	U		P
7440-62-2	Vanadium	34.4			P
7440-66-6	Zinc	863		*	P
	Cyanide	1.15 2.9	U		C

mm 12/30/98

Color Before: GREY

Clarity Before: OPAQUE

Texture: MEDIUM

Color After: YELLOW

Clarity After: CLEAR

Artifacts:

Comments:

000006

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

GGTP15

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #06960

Matrix (soil/water): SOIL

Lab Sample ID: 98055980

Level (low/med): LOW

Date Received: 12/04/98

% Solids: 66.7

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	7780			P
7440-36-0	Antimony	0.99	U	N	P
7440-38-2	Arsenic	12.3			P
7440-39-3	Barium	529		N	P
7440-41-7	Beryllium	0.73	B		P
7440-43-9	Cadmium	0.22	B		P
7440-70-2	Calcium	4850			P
7440-47-3	Chromium	21.6			P
7440-48-4	Cobalt	8.7	B		P
7440-50-8	Copper	124		N	P
7439-89-6	Iron	20700			P
7439-92-1	Lead	1430			P
7439-95-4	Magnesium	645	B		P
7439-96-5	Manganese	228			P
7439-97-6	Mercury	0.62		*	CV
7440-02-0	Nickel	26.2			P
7440-09-7	Potassium	1420	B		P
7782-49-2	Selenium	4.1			P
7440-22-4	Silver	0.45	U		P
7440-23-5	Sodium	568	B		P
7440-28-0	Thallium	1.1	U		P
7440-62-2	Vanadium	39.3			P
7440-66-6	Zinc	1010		*	P
	Cyanide	0.76	U		C

mmp 12/30/98

Color Before: GREY

Clarity Before: OPAQUE

Texture: MEDIUM

Color After: YELLOW

Clarity After: CLEAR

Artifacts:

Comments:

FORM I - IN

C00011

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1
INORGANIC ANALYSIS DATA SHEET

GTP16d

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #06960

Matrix (soil/water): SOIL

Lab Sample ID: 98055990

Level (low/med): LOW

Date Received: 12/04/98

% Solids: 51.5

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	11900	-		P
7440-36-0	Antimony	1.3	U	N	P
7440-38-2	Arsenic	40.8	-		P
7440-39-3	Barium	194	-	N	P
7440-41-7	Beryllium	0.64	B		P
7440-43-9	Cadmium	0.67	B		P
7440-70-2	Calcium	4680	-		P
7440-47-3	Chromium	56.1	-		P
7440-48-4	Cobalt	36.0	-		P
7440-50-8	Copper	343	-	N	P
7439-89-6	Iron	80800	-		P
7439-92-1	Lead	632	-		P
7439-95-4	Magnesium	1220	B		P
7439-96-5	Manganese	735	-		P
7439-97-6	Mercury	0.46	-	*	CV
7440-02-0	Nickel	104	-		P
7440-09-7	Potassium	967	B		P
7782-49-2	Selenium	4.2	-		P
7440-22-4	Silver	0.58	U		P
7440-23-5	Sodium	437	B		P
7440-28-0	Thallium	1.5	U		P
7440-62-2	Vanadium	41.3	-		P
7440-66-6	Zinc	1510	-	*	P
	Cyanide	0.97	U		C

mmp 12/30/98

Color Before: BLACK

Clarity Before: OPAQUE

Texture: MEDIUM

Color After: YELLOW

Clarity After: CLEAR

Artifacts:

Comments:

C00010

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1
INORGANIC ANALYSIS DATA SHEET

GGTP9d

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #06960

Matrix (soil/water): SOIL

Lab Sample ID: 98055960

Level (low/med): LOW

Date Received: 12/04/98

% Solids: 54.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	12700			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	18.0			P
7440-39-3	Barium	216		N	P
7440-41-7	Beryllium	0.69	B		P
7440-43-9	Cadmium	1.2	B		P
7440-70-2	Calcium	3610			P
7440-47-3	Chromium	31.3			P
7440-48-4	Cobalt	13.4	B		P
7440-50-8	Copper	94.9		N	P
7439-89-6	Iron	44500			P
7439-92-1	Lead	546			P
7439-95-4	Magnesium	1450	B		P
7439-96-5	Manganese	607			P
7439-97-6	Mercury	0.79		*	CV
7440-02-0	Nickel	35.8			P
7440-09-7	Potassium	731	B		P
7782-49-2	Selenium	2.9			P
7440-22-4	Silver	0.56	U		P
7440-23-5	Sodium	177	B		P
7440-28-0	Thallium	1.4	U		P
7440-62-2	Vanadium	41.5			P
7440-66-6	Zinc	889		*	P
	Cyanide	0.92 2.7	U		C

mr 12/30/98

Color Before: BLACK

Clarity Before: OPAQUE

Texture: MEDIUM

Color After: YELLOW

Clarity After: CLEAR

Artifacts:

Comments:

000009

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1
INORGANIC ANALYSIS DATA SHEET

GGTP4s

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #06960

Matrix (soil/water): SOIL

Lab Sample ID: 98055910

Level (low/med): LOW

Date Received: 12/04/98

% Solids: 71.1

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	8840			P
7440-36-0	Antimony	0.93	U	N	P
7440-38-2	Arsenic	8.5			P
7440-39-3	Barium	334		N	P
7440-41-7	Beryllium	0.82	B		P
7440-43-9	Cadmium	0.03	U		P
7440-70-2	Calcium	8100			P
7440-47-3	Chromium	29.2			P
7440-48-4	Cobalt	9.5	B		P
7440-50-8	Copper	121		N	P
7439-89-6	Iron	17100			P
7439-92-1	Lead	1510			P
7439-95-4	Magnesium	725	B		P
7439-96-3	Manganese	210			P
7439-97-6	Mercury	0.39		*	CV
7440-02-0	Nickel	21.7			P
7440-09-7	Potassium	1090	B		P
7782-49-2	Selenium	2.1			P
7440-22-4	Silver	0.42	U		P
7440-23-5	Sodium	301	B		P
7440-28-0	Thallium	1.1	U		P
7440-62-2	Vanadium	43.0			P
7440-66-6	Zinc	341		*	P
	Cyanide	0.70 2.8	U		C

mno 12/30/98

Color Before: GREY

Clarity Before: OPAQUE

Texture: MEDIUM

Color After: YELLOW

Clarity After: CLEAR

Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

000007

SAMPLE NO.

1
INORGANIC ANALYSIS DATA SHEET

GGTP2d

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #06960

Matrix (soil/water): SOIL

Lab Sample ID: 98055890

Level (low/med): LOW

Date Received: 12/04/98

% Solids: 83.3

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	8750			P
7440-36-0	Antimony	0.79	U	N	P
7440-38-2	Arsenic	0.96	U		P
7440-39-3	Barium	76.1		N	P
7440-41-7	Beryllium	0.54	B		P
7440-43-9	Cadmium	0.02	U		P
7440-70-2	Calcium	3080			P
7440-47-3	Chromium	15.8			P
7440-48-4	Cobalt	16.0			P
7440-50-8	Copper	4.1	B	N	P
7439-89-6	Iron	36400			P
7439-92-1	Lead	2.1			P
7439-95-4	Magnesium	1670			P
7439-96-5	Manganese	439			P
7439-97-6	Mercury	0.06	U	*	CV
7440-02-0	Nickel	26.2			P
7440-09-7	Potassium	158	U		P
7782-49-2	Selenium	0.96	U		P
7440-22-4	Silver	0.36	U		P
7440-23-5	Sodium	33.7	U		P
7440-28-0	Thallium	0.91	U		P
7440-62-2	Vanadium	36.2			P
7440-66-6	Zinc	18.7		*	P
	Cyanide	0.60 2.4	U		C

7/12/29/98

Color Before: BROWN

Clarity Before: OPAQUE

Texture: MEDIUM

Color After: YELLOW

Clarity After: CLEAR

Artifacts:

Comments:

FORM I - IN

000005

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1
INORGANIC ANALYSIS DATA SHEET

GGSW-2

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #06960

Matrix (soil/water): WATER

Lab Sample ID: 98056020

Level (low/med): LOW

Date Received: 12/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	15.5	U		P
7440-36-0	Antimony	3.3	U		P
7440-38-2	Arsenic	4.0	U		P
7440-39-3	Barium	0.43	B		P
7440-41-7	Beryllium	0.10	U		P
7440-43-9	Cadmium	0.10	U		P
7440-70-2	Calcium	115	U		P
7440-47-3	Chromium	6.4	B		P
7440-48-4	Cobalt	0.60	U		P
7440-50-8	Copper	3.3	B		P
7439-89-6	Iron	43.7	B		P
7439-92-1	Lead	3.1			P
7439-95-4	Magnesium	16.9	B		P
7439-96-5	Manganese	1.1	B		P
7439-97-6	Mercury	0.10	U	*	CV
7440-02-0	Nickel	6.7	B		P
7440-09-7	Potassium	660	U		P
7782-49-2	Selenium	4.0	U		P
7440-22-4	Silver	1.5	U		P
7440-23-5	Sodium	5260			P
7440-28-0	Thallium	3.8	U		P
7440-62-2	Vanadium	0.60	U		P
7440-66-6	Zinc	4.3	B		P
	Cyanide	10.0	U		C

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

Site Name: *George Gray*

DATA SUMMARY FORM: INORGANICS

Sampling Date(s): *12/1, 2/99*

TEP Soil
(Media) SAMPLES *mg/L*
(Units)

Sample Number	Sample Location	<i>66TP40</i>		<i>66TP9D</i>							
Analyte											
Aluminum											
Antimony											
Arsenic		<i>.0296</i>		<i>.0452</i>							
Barium		<i>.567</i>		<i>1.04</i>							
Beryllium											
Cadmium											
Calcium											
Chromium											
Cobalt											
Copper											
Iron											
Lead		<i>1.59</i>		<i>3.07</i>							
Magnesium											
Manganese											
Mercury											
Nickel											
Potassium											
Selenium		<i>.007</i>		<i>.0091</i>							
Silver											
Sodium											
Thallium											
Vanadium											
Zinc											
Cyanide											

ENVIROFORMS/INORGANIC CLP

000003

SAMPLE NO.

1
INORGANIC ANALYSIS DATA SHEET

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

4cGGTP

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #06960

Matrix (soil/water): WATER

Lab Sample ID: 98055920

Level (low/med): LOW

Date Received: 12/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum		B		
7440-36-0	Antimony				
7440-38-2	Arsenic	29.6			P
7440-39-3	Barium	567			P
7440-41-7	Beryllium				
7440-43-9	Cadmium	3.9	B		P
7440-70-2	Calcium				
7440-47-3	Chromium	1.1	B		P
7440-48-4	Cobalt				
7440-50-8	Copper				
7439-89-6	Iron		B		
7439-92-1	Lead	1590			P
7439-95-4	Magnesium		B		
7439-96-5	Manganese				
7439-97-6	Mercury	0.10	U	*	CV
7440-02-0	Nickel				
7440-09-7	Potassium				
7782-49-2	Selenium	7.0		N	P
7440-22-4	Silver	1.5	U		P
7440-23-5	Sodium				
7440-28-0	Thallium				
7440-62-2	Vanadium				
7440-66-6	Zinc				
	Cyanide				

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

TCLP EXTRACT

FORM I - IN

000004

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1
INORGANIC ANALYSIS DATA SHEET

9dGGTP

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #06960

Matrix (soil/water): WATER

Lab Sample ID: 98055960

Level (low/med): LOW

Date Received: 12/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum				
7440-36-0	Antimony				
7440-38-2	Arsenic	45.2			P
7440-39-3	Barium	1040			P
7440-41-7	Beryllium				
7440-43-9	Cadmium	0.10	U		P
7440-70-2	Calcium				
7440-47-3	Chromium	1.4	B		P
7440-48-4	Cobalt				
7440-50-8	Copper				
7439-89-6	Iron				
7439-92-1	Lead	3070			P
7439-95-4	Magnesium		B		
7439-96-5	Manganese				
7439-97-6	Mercury	0.10	U	*	CV
7440-02-0	Nickel				
7440-09-7	Potassium				
7782-49-2	Selenium	9.1			P
7440-22-4	Silver	2.0	B		P
7440-23-5	Sodium				
7440-28-0	Thallium				
7440-62-2	Vanadium				
7440-66-6	Zinc				
	Cyanide				

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

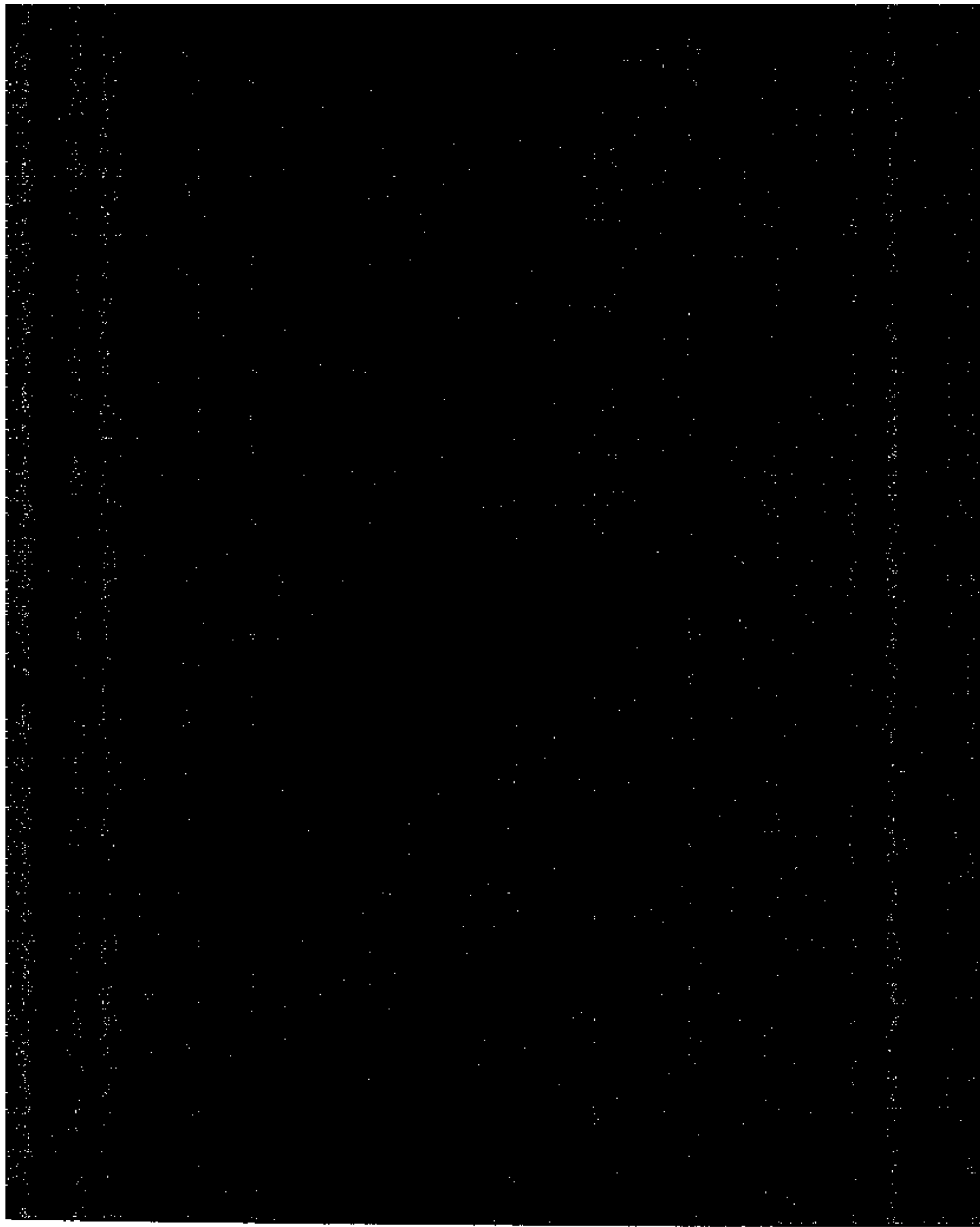
Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

TCLP EXTRACT



**DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENTAL CONTROL
DIVISION OF AIR & WASTE MANAGEMENT
Site Investigation & Restoration Branch**

MEMORANDUM

Date: March 11, 1999

Subject: George Gray School Organic Data Validation

From: Robert M. Schulte *RM/ 3/11/99*

To: Lawrence J. Jones
Project Officer

Through: Karl F. Kalbacher *KFC 3/11/99*
Program Manager

Overview

The Sample Delivery Group consisted of ten (10) soil samples collected by the Site Investigation & Restoration Branch (SIRB) of the Department of Natural Resources and Environmental Control (DNREC). The SDG included one (1) rinse blank (SW-2), one trip blank (SW-1) and two (2) nonaqueous field duplicate pairs (GGTP-15 and GGTP-4C, GGTP-16 and GGTP-9D). The field duplicate pairs were not selected for organic analysis. All samples were field screened. Analysis selection was based upon the field screening results. The field duplicate pairs did not require organic analysis. The DNREC Environmental Services Section analyzed samples for Semivolatiles (7 samples), volatile (1 sample) and Pesticide/PCBs (1 sample) per the chain of custody. The samples were analyzed in accordance with the Standard Operating Procedures for Chemical Analytical Programs (SOPCAP) under the Hazardous Substance Cleanup Act (HSCA).

Summary

All samples were successfully analyzed for all targeted compounds. All instrument and method sensitivities were in accordance with the SOPCAP of HSCA.

Areas of concern with respect to usability are listed below according to the seriousness of the issue.

Major Issues

A practical quantitation limit standard was analyzed prior to any semivolatile sample analysis. The practical quantitation limit standard was 1 ng/ul. The standard CLP PQL standard is 10 ng/ul. This makes the practical quantitation limit ten times less than as reported on the CLP form 1's. The end data user should be aware of the variation.

Minor Issues

The semivolatile matrix spike and matrix duplicate recoveries and relative percent differences were reported outside of validation quality control limits. The Pyrene and Acenaphthene spike recoveries were elevated due to the presence of part per million levels of polyaromatic hydrocarbons. No qualification is necessary. A comparison of all nonspike compounds is as follows:

Concentration ug/Kg

Compound	GGTP-10D	GGTP10MS	GGTP10MSD	%RSD
Flourene	430	960	2001	21
Phenanthrene	2600	6300	1300	17
Anthracene	740	1500	330	22
Flouranthene	2800	5300	1500	28
Benzo(a)anthracene	2000	3800	1200	30
Chrysene	2000	3500	1200	35
Benzo(b)flouranthene	1800	2800	920	35
Benzo(a)pyrene	1400	2300	940	39
Indeno(1,2,3-cd)pyrene	1200	2000	810	39
Benzo(k)flouranthene	640	1100	670	48
Dibenz(a,h)anthracene	450	940	340	31
Benzo(g,h,i)perylene	1000	1400	670	45

*Results outside of validation quality control limits

The semivolatile samples GGTP3S, GGSS4, GGTP10D, and GGTP6S were diluted. The sample extract was diluted to bring calibrated compounds within the linear range of the instrument. "E" flagged data will not be reported on the data summary table. The sample chromatogram exhibits coal ash/tar C11-C22 aromatic petroleum patterns. The results do not exceed HSCA guidance except GGTP3S. No qualification is necessary.

Notes

The maximum concentration of all compounds found in the analyses of the rinsate and preparation blanks are listed below. Samples with concentrations of common laboratory contaminants less than ten times ($<10\times$) the blank concentration or with concentrations of other contaminants less than five times ($<5\times$) the blank concentration will be excluded from the data summary tables and not considered chemicals of concern. The following compounds were found: bis(2-Ethylhexyl)phthalate 31 ug/Kg.

Semivolatile ending calibration C1703, contains Hexachlorobutadiene, Hexachloroethane, Benzo[k]fluoranthene, Indeno[1,2,3-cd]pyrene, Dibenz(a,h)anthracene and Benzo(g,h,i)perylene outside of validation quality control limits. All positive results and practical quantitation limits will be qualified "J" and "UJ" as estimated for these compounds, respectively, for the following samples: GGSW2.

Semivolatile ending calibration C1736 contains N-Nitroso-di-n-propyl-amine, 4-Nitroaniline and Benzo[k]fluoranthene outside of validation quality control limits. All positive results and practical quantitation limits will be qualified "J" and "UJ" as estimated for these compounds, respectively, for the following samples: GGTP3S.

Semivolatile ending calibration C1732 contains Hexachlorocyclopentadiene, Indeno[1,2,3-cd]pyrene and Benzo(g,h,i)perylene outside of validation quality control limits. All positive results and practical quantitation limits will be qualified "J" and "UJ" as estimated for these compounds, respectively, for the following samples: GGTP2D, GGSS4, GGTP5S, GGTP6S and GGTP9S.

All volatile, semivolatile and Pesticide/PCB initial and continuing calibrations were within validation quality control limits. No qualification is necessary.

All volatile, semivolatile and pesticide/PCB system monitoring compounds were within validation quality control limits. No qualification is necessary.

All volatile and semivolatile response factors were within validation quality control limits. No qualification is necessary.

All volatile and semivolatile system performance checks were within validation quality control limits. No qualification is necessary.

All Pesticide/PCB, semivolatile and volatile laboratory control samples were

Lawrence J. Jones
George Gray School
March 11, 1999

within validation quality control limits. No qualification is necessary.

All data was reviewed in accordance with National Functional Guidelines for Evaluating Organic Analyses with modification for use in EPA Region III.

All TICs were identified with a functionality group (e.g. unknown PAH). Unidentifiable TICs were accompanied with a "?" and the spectra and/or spectrum are included with the sample results behind the data summary tables. Some peaks are unidentifiable due to non-spectra matches or coelutions.

The preparation and analysis holding times for all samples were within validation quality control limits. No qualification is necessary.

All cleanup procedures were performed on the sample.

No field duplicate comparison could be achieved.

Attachments

Laboratory Form IS
Reviewed and Corrected Tentatively Identified Compounds
Support Documentation
Chain of Custody

RMS:slb
RMS99018.doc
DE-1138 II A 3

FIELD CHAIN OF CUSTODY



Client: DURET-SR2B
Address: 391 LUKENS DRIVE
NEWCASTLE, DE 19720
Phone: (302) 395-2600

Report To: ROBSON SCIENCE
Invoice To: ROBSON SCIENCE
Account:
ESS No.: 06960

PROJECT NAME		ANALYSES				REMARKS
ESS only Lab Log No.	Client Sample Description	Sample Date	Sample Time	Matrix* Comp.	Grab	
98055890	GGTP-2d	12/1	1110	50	X	15-9d 16-9d MS/MSD
98055890	GGTP-3d	12/1	1215	50	X	
98055890	GGTP-4d	12/1	1320	50	X	
98055890	GGTP-4d	12/1	1330	50	X	
98055890	GGTP-5d	12/1	1425	50	X	
98055890	GGTP-10d	12/2	1400	50	X	
98055890	GGTP-9d	12/2	1150	50	X	
98055890	GGTP-9d	12/2	1215	50	X	
98055890	GGTP-10d	12/2	0935	50	X	
98055890	GGTP-15d	12/1	1345	50	X	

Potential Hazard Identification: Non-Hazard ☐ Flammable ☒ Toxic ☒ Skin-Irritant ☒ Other ☐

Sample Disposal: Return to Client ☐ Disposal by ESS ☒ Authorized by: [Signature]

RELINQUISHED BY: (signature) [Signature] DATE: 12/3/98 TIME: 1630

RECEIVED BY: (signature) [Signature] DATE: 12-7-98 TIME: 0935

COMMENTS:

ESS USE ONLY

Sample Condition:
1. Shipped or Hand-delivered: ☒ 2. Chilled or Ambient: ☒ 3. Received intact/unleaking: ☒ 4. Properly preserved: ☒ 5. Holding time/expired: ☒ 6. Bottles supplied by ESS: ☒ 7. Field Filtered: ☒

Notes: ESS purp T/C: 1/12

Custody Seal: War

1. Preservation outer package: ☒ 2. Unbroken on outer package: ☒ 3. Present on sample: ☒ 4. Unbroken on sample: ☒ 5. Discrepancies between sample labels and CQC record? ☒



Client:

DNRZ-SLB

Revised To: ROBERT SCHULTE

Address:

391 LUKENS DR.

Invoice To: RDBGV SCULTE

NEWCASTLE DE 19720

Account:

Figure 2:

(302) 395-2600

ESS No.:

PROJECT NAME GEORGE GRAY ELEM. SCHOOL									
SAMPLERS (Signature)									
<div> <div>ESS only</div> <div>Lab Log No.</div> </div>									
Client Sample Description		Sample Date	Sample Time	Matrix*	Comp	Grab	No. of Containers	ANALYSES	
								BN+LIG	PCB/PCB
98055990	66TP-16d	12/2	1215	SW		X	4	1	1
98056000	66SS-4	12/2	1445	SW		X	4	1	1
98056010	66SW-1	12/1	0730	SW		X	4	1	1
98056020	66SW-2	12/2	1515	SW		X	8	1	1
/									
<div> <div>Potential Hazard Identification:</div> <div>Non-Hazard <input type="checkbox"/> Flammable <input checked="" type="checkbox"/> Toxic <input checked="" type="checkbox"/> Skin-irritant <input checked="" type="checkbox"/> Other <input type="checkbox"/></div> </div>									
<div> <div>Sample Disposal:</div> <div>Return to Client <input type="checkbox"/> Disposal by ESS <input checked="" type="checkbox"/> Authorized by: </div> </div>									
RELINQUISHED BY: (signature)		DATE	TIME		RECEIVED BY: (signature)				
		12/3/98	1630						
		12-7-98	0935		ESS only:				
COMMENTS:									

ESS USE ONLY:

Sample Condition:

...to provide a...

✓ **Sty: 11-15**
✓ Sty: 16-20
✓ Sty: 21-25
✓ Sty: 26-30
✓ Sty: 31-35
✓ Sty: 36-40
✓ Sty: 41-45
✓ Sty: 46-50
✓ Sty: 51-55
✓ Sty: 56-60
✓ Sty: 61-65
✓ Sty: 66-70
✓ Sty: 71-75
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Notes:...

Custody Seal Waiver

1. Presentation of the course

524

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030216.KAK

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Site Name: George Gray School
 Sampling Date: 12/3/98

DATA SUMMARY FORM: SEMIVOLATILE (1)

Soil
 (Media) SAMPLES
 (UNITS) ug/kg

Sample Number Dilution Factor Sample Location	GC-SS4	GGTP100	GGTP2D	GGTP3S	GGTP5S	GGTP6S	GGTP9S	14912 GGSW2
Thenol								
Bis(2-Chloroethyl)ether								
2-Chlorophenol								
1,3-Dichlorobenzene								
1,4-Dichlorobenzene								
1,2-Dichlorobenzene								
2-Methylphenol								
2,2'-oxybis(1-Chloropropane)								
4-Methylphenol								
N-Nitroso-di-n-propylamine				45				45
Hexachloroethane								
Nitrobenzene								
Isophorone								
2-Nitrophenol								
2,4-Dimethylphenol								
Bis(2-Chloroethoxy)methane								
2,4-Dichlorophenol								
1,2,4-Trichlorobenzene		140	5	130	5	170	5	120
Naphthalene	920							
4-Chloroaniline								

Site Name: George Gray School
 Sample Date: 12/2/1991

DATA SUMMARY FORM: SEMIVOLATILE (2)

Soil
 (Media) SAMPLES
 (UNITS) ug/Kg

Sample Number Dilution Factor Sample Location	GG-SS4	GG-TN100	GG-TPAD	GG-TB35	GG-TB55	GG-TB65	GG-TB85	49/L	1
Hexachlorobutadiene									
4-Chloro-3-methylphenol									
2-Methylnaphthalene	300	95 J		83 J		110 J	75 J		
Hexachlorocyclopentadiene		45	45		45	65	45		
2,4,6-Trichlorophenol									
2,4,5-Trichlorophenol									
2-Chloronaphthalene									
2-Nitroaniline									
1-Methylphtalate									
Acenaphthylene		180 J		170 J	51 J	160 J	210 J		
2,6-Dinitrochloroene									
3-Nitroaniline									
Acenaphthene	1500	30000 J		840		240 J	150 J		
2,4-Dinitrophenol									
4-Nitrophenol									
Chloracetylene	970	10000 J		210		190 J	160 J		
2,4-Dinitrochloroene									
1-Methylphtalate									
4-Chlorophenyl-phenyl ether									
Fluorene	1300	430		1200	20 J	230 J	200 J		
4-Nitroaniline									
4,6-Dinitro-2-methylphenol									

DATA SUMMARY FORM: SEMI-VOLATILE (3)

Soit (Media) SAMPLES

(UNITS) 491 kg

Page 1

DATA SUMMARY FORM: VOLATILES (1)

Spiz
(Media) SAMPLES

(UNITS) $\mu\text{g/Kg}$

[illegible]

DATA SUMMARY FORM: VOLATILES (2)

Spit (Media) SAMPLES

(UNITS) $\mu\text{g/Kg}$

[illegible]

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGTP2D

Lab Name: DE DNREC:DIV OF WATER RES.

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805589

C00030

Sample wt/vol: 250.6 (g/mL) G

Lab File ID: D11236.D

Level: (low/med) MED

Date Received: 12/7/98

% Moisture: not dec. 0

Date Analyzed: 12/9/98

GC Column: DB624 ID: 0.53 (mm)

Dilution Factor: 1.0

Soil Extract Volume: 100000 (uL)

Soil Aliquot Volume: 100 (uL)

CAS No.	Compound	Concentration Units:	
		(ug/L or ug/Kg)	ug/Kg
			Q
74-87-3	Chloromethane	200	U
74-83-9	Bromomethane	200	U
75-01-4	Vinyl Chloride	200	U
75-00-3	Chloroethane	200	U
75-09-2	Methylene Chloride	200	U
67-64-1	Acetone	200	U
75-15-0	Carbon Disulfide	200	U
75-35-4	1,1-Dichloroethene	200	U
75-34-3	1,1-Dichloroethane	200	U
540-59-0	1,2-Dichloroethene (total)	200	U
67-66-3	Chloroform	200	U
107-06-2	1,2-Dichloroethane	200	U
78-93-3	2-Butanone	200	U
71-55-6	1,1,1-Trichloroethane	200	U
56-23-5	Carbon Tetrachloride	200	U
75-27-4	Bromodichloromethane	200	U
78-87-5	1,2-Dichloropropane	200	U
10061-01-5	cis-1,3-Dichloropropene	200	U
79-01-6	Trichloroethene	200	U
124-48-1	Dibromochloromethane	200	U
79-00-5	1,1,2-Trichloroethane	200	U
71-43-2	Benzene	200	U
10061-02-6	trans-1,3-Dichloropropene	200	U
75-25-2	Bromoform	200	U
108-10-1	4-Methyl-2-Pentanone	200	U
591-78-6	2-Hexanone	200	U
127-18-4	Tetrachloroethene	200	U
79-34-5	1,1,2,2-Tetrachloroethane	200	U
108-88-3	Toluene	200	U
108-90-7	Chlorobenzene	200	U
100-41-4	Ethylbenzene	200	U
100-42-5	Styrene	200	U
1330-20-7	Xylene (total)	200	U

FORM I VOA

3/90

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

GGTP2D

Lab Name: DE DNREC:DIV OF WATER RES.

Contract: DNREC:DAWM

000031

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805589

Sample wt/vol: 250.6 (g/mL) G

Lab File ID: D11236.D

Level: (low/med) MED

Date Received: 12/7/98

% Moisture: not dec. 0

Date Analyzed: 12/9/98

GC Column: DB624

ID: 0.53 (mm)

Dilution Factor: 1.0

Soil Extract Volume: 100000 (uL)

Soil Aliquot Volume: 100 (uL)

Concentration Units:

Number TICs found: 0

(ug/L or ug/Kg) ug/Kg

CAS Number	Compound Name	RT	Est. Conc.	Q
1.				
2.				
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25.				
26.				
27.				
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29.				
30.				

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGSW1

Lab Name: DE DNREC:DIV OF WATER RES.

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) WATER

Lab Sample ID: 9805601

000020

Sample wt/vol: 5.0 (g/mL) ML

Lab File ID: D11230.D

Level: (low/med) _____

Date Received: 12/7/98

% Moisture: not dec. 0

Date Analyzed: 12/9/98

GC Column: DB624 ID: 0.53 (mm)

Dilution Factor: 1.0

Soil Extract Volume: _____ (uL)

Soil Aliquot Volume: _____ (uL)

CAS No.	Compound	Concentration Units:		Q
		(ug/L or ug/Kg)	ug/L	
74-87-3	Chloromethane	10		U
74-83-9	Bromomethane	10		U
75-01-4	Vinyl Chloride	10		U
75-00-3	Chloroethane	10		U
75-09-2	Methylene Chloride	10		U
67-64-1	Acetone	10		U
75-15-0	Carbon Disulfide	10		U
75-35-4	1,1-Dichloroethene	10		U
75-34-3	1,1-Dichloroethane	10		U
540-59-0	1,2-Dichloroethene (total)	10		U
67-66-3	Chloroform	10		U
107-06-2	1,2-Dichloroethane	10		U
78-93-3	2-Butanone	10		U
71-55-6	1,1,1-Trichloroethane	10		U
56-23-5	Carbon Tetrachloride	10		U
75-27-4	Bromodichloromethane	10		U
78-87-5	1,2-Dichloropropane	10		U
10061-01-5	cis-1,3-Dichloropropene	10		U
79-01-6	Trichloroethene	10		U
124-48-1	Dibromochloromethane	10		U
79-00-5	1,1,2-Trichloroethane	10		U
71-43-2	Benzene	10		U
10061-02-6	trans-1,3-Dichloropropene	10		U
75-25-2	Bromoform	10		U
108-10-1	4-Methyl-2-Pentanone	10		U
591-78-6	2-Hexanone	10		U
127-18-4	Tetrachloroethene	10		U
79-34-5	1,1,2,2-Tetrachloroethane	10		U
108-88-3	Toluene	10		U
108-90-7	Chlorobenzene	10		U
100-41-4	Ethylbenzene	10		U
100-42-5	Styrene	10		U
1330-20-7	Xylene (total)	10		U

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

GGSW1

Lab Name: DE DNREC:DIV OF WATER RES.

Contract: DNREC:DAWM

000021

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) WATER

Lab Sample ID: 9805601

Sample wt/vol: 5.0 (g/mL) ML

Lab File ID: D11230.D

Level: (low/med) _____

Date Received: 12/7/98

% Moisture: not dec. 0

Date Analyzed: 12/9/98

GC Column: DB624

ID: 0.53 (mm)

Dilution Factor: 1.0

Soil Extract Volume: _____ (uL)

Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

Concentration Units:

(ug/L or ug/Kg) ug/L

CAS Number	Compound Name	RT	Est. Conc.	Q
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
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22.				
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28.				
29.				
30.				

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGSW2

Lab Name: DE DNREC:DIV OF WATER RES.

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) WATER

Lab Sample ID: 9805602

000025

Sample wt/vol: 5.0 (g/mL) ML

Lab File ID: D11231.D

Level: (low/med) _____

Date Received: 12/7/98

% Moisture: not dec. 0

Date Analyzed: 12/9/98

GC Column: DB624 ID: 0.53 (mm)

Dilution Factor: 1.0

Soil Extract Volume: _____ (uL)

Soil Aliquot Volume: _____ (uL)

CAS No.	Compound	Concentration Units:	
		(ug/L or ug/Kg)	ug/L
			Q
74-87-3	Chloromethane	10	U
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	10	U
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	10	U
75-35-4	1,1-Dichloroethene	10	U
75-34-3	1,1-Dichloroethane	10	U
540-59-0	1,2-Dichloroethene (total)	10	U
67-66-3	Chloroform	10	U
107-06-2	1,2-Dichloroethane	10	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	10	U
56-23-5	Carbon Tetrachloride	10	U
75-27-4	Bromodichloromethane	10	U
78-87-5	1,2-Dichloropropane	10	U
10061-01-5	cis-1,3-Dichloropropene	10	U
79-01-6	Trichloroethene	10	U
124-48-1	Dibromochloromethane	10	U
79-00-5	1,1,2-Trichloroethane	10	U
71-43-2	Benzene	10	U
10061-02-6	trans-1,3-Dichloropropene	10	U
75-25-2	Bromoform	10	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	10	U
79-34-5	1,1,2,2-Tetrachloroethane	10	U
108-88-3	Toluene	10	U
108-90-7	Chlorobenzene	10	U
100-41-4	Ethylbenzene	10	U
100-42-5	Styrene	10	U
1330-20-7	Xylene (total)	10	U

FORM I VOA

3/90

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

GGSW2

000026

Lab Name: DE DNREC:DIV OF WATER RES.

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) WATER

Lab Sample ID: 9805602

Sample wt/vol: 5.0 (g/mL) ML

Lab File ID: D11231.D

Level: (low/med) _____

Date Received: 12/7/98

% Moisture: not dec. 0

Date Analyzed: 12/9/98

GC Column: DB624

ID: 0.53 (mm)

Dilution Factor: 1.0

Soil Extract Volume: _____ (uL)

Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

Concentration Units:
(ug/L or ug/Kg) ug/L

CAS Number	Compound Name	RT	Est. Conc.	Q
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
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28.				
29.				
30.				

Site Name: George Gray School
Sampling Date(s): 12/11/98

DATA SUMMARY FORM: PESTICIDES AND PCB'S

**Soil
(Media) SAMPLES**

(UNITS) *g/kg*

[illegible]

000642

1D
PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGSW-2

Lab Name: DE DNREC: Div of Water Res Contract: DNREC: DAWM

Lab Code: DE023

Case No.

SAS No.:

SDG No.: #6960

Matrix: (soil/water) WATER

Lab Sample ID: GC3A7673

Sample wt/vol: 1000 (g/ml) ML

Lab File ID:

% Moisture: decanted: (Y/N)

Date Received: 12/07/98

Extraction: (SepF/Cont/Sonc) CONT

Date Extracted: 12/08/98

Concentrated Extract Volume: 10000 (uL)

Date Analyzed: 12/29/98

Injection Volume: 1.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 7.0

Sulfur Cleanup: (Y/N) N

CAS NO.	COMPOUND	CONCENTRATION UNITS (ug/L or ug/Kg) UG/L	Q
---------	----------	---	---

319-84-6	alpha-BHC	0.05	U
319-85-7	beta-BHC	0.05	U
319-86-8	delta-BHC	0.05	U
58-89-9	gamma-BHC (Lindane)	0.05	U
76-44-8	Heptachlor	0.05	U
309-00-2	Aldrin	0.05	U
111024-57	Heptachlor epoxide	0.05	U
959-98-8	Endosulfan I	0.05	U
60-57-1	Dieldrin	0.10	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.10	U
33213-65-9	Endosulfan II	0.10	U
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.50	U
53494-70-5	Endrin ketone	0.10	U
7421-93-4	Endrin aldehyde	0.10	U
5103-71-9	alpha-Chlordane	0.05	U
5103-74-2	gamma-Chlordane	0.05	U
8001-35-2	Toxaphene	5.0	U
12674-11-2	Aroclor-1016	1.0	U
11104-28-2	Aroclor-1221	2.0	U
11141-16-5	Aroclor-1232	1.0	U
53469-21-9	Aroclor-1242	1.0	U
12672-29-6	Aroclor-1248	1.0	U
11097-69-1	Aroclor-1254	1.0	U
11096-82-5	Aroclor-1260	1.0	U

FORM I PEST

OLM02.0

000647

1D
PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

Lab Name: DE DNREC: Div of Water Res Contract: DNREC: DAWM

GGTP-2D

Lab Code: DE023 Case No. SAS No.: SDG No.: #6960

Matrix: (soil/water) SOIL Lab Sample ID: GC3A7726

Sample wt/vol: 30.0 (g/ml) G Lab File ID:

% Moisture: 17 decanted: (Y/N) N Date Received: 12/07/98

Extraction: (SepF/Cont/Sonc) SONC Date Extracted: 12/09/98

Concentrated Extract Volume: 5000 (uL) Date Analyzed: 1/07/99

Injection Volume: 1.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 4.8 Sulfur Cleanup: (Y/N) N

CAS NO.	COMPOUND	CONCENTRATION UNITS (ug/L or ug/Kg) UG/KG	Q
319-84-6	alpha-BHC	2.0	U
319-85-7	beta-BHC	2.0	U
319-86-8	delta-BHC	2.0	U
58-89-9	gamma-BHC (Lindane)	2.0	U
76-44-8	Heptachlor	2.0	U
309-00-2	Aldrin	2.0	U
111024-57	Heptachlor epoxide	2.0	U
959-98-8	Endosulfan I	2.0	U
60-57-1	Dieldrin	4.0	U
72-55-9	4,4'-DDE	4.0	U
72-20-8	Endrin	4.0	U
33213-65-9	Endosulfan II	4.0	U
72-54-8	4,4'-DDD	4.0	U
1031-07-8	Endosulfan sulfate	4.0	U
50-29-3	4,4'-DDT	4.0	U
72-43-5	Methoxychlor	20.	U
53494-70-5	Endrin ketone	4.0	U
7421-93-4	Endrin aldehyde	4.0	U
5103-71-9	alpha-Chlordane	2.0	U
5103-74-2	gamma-Chlordane	2.0	U
8001-35-2	Toxaphene	200.	U
12674-11-2	Aroclor-1016	40.	U
11104-28-2	Aroclor-1221	81.	U
11141-16-5	Aroclor-1232	40.	U
53469-21-9	Aroclor-1242	40.	U
12672-29-6	Aroclor-1248	40.	U
11097-69-1	Aroclor-1254	40.	U
11096-82-5	Aroclor-1260	40.	U

FORM I PEST

OLM02.0

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGSS4

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805600

000114

Sample wt/vol: 30.2 (g/mL) G

Lab File ID: P2135.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 17 decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.36

Concentration Units:

CAS No.	Compound	(ug/L or ug/Kg)	ug/Kg	Q
111-44-4	bis(2-Chloroethyl)ether	400		U
541-73-1	1,3-Dichlorobenzene	400		U
106-46-7	1,4-Dichlorobenzene	400		U
95-50-1	1,2-Dichlorobenzene	400		U
108-60-1	2,2'-oxybis(1-Chloropropane)	400		U
67-72-1	Hexachloroethane	400		U
621-64-7	N-Nitroso-di-n-propylamine	400		U
98-95-3	Nitrobenzene	400		U
78-59-1	Isophorone	400		U
111-91-1	bis(2-Chloroethoxy)methane	400		U
120-82-1	1,2,4-Trichlorobenzene	400		U
91-20-3	Naphthalene	920		
106-47-8	4-Chloroaniline	400		U
87-68-3	Hexachlorobutadiene	400		U
91-57-6	2-Methylnaphthalene	700		
77-47-4	Hexachlorocyclopentadiene	400		U
91-58-7	2-Chloronaphthalene	400		U
88-74-4	2-Nitroaniline	400		U
208-96-8	Acenaphthylene	390		J
131-11-3	Dimethylphthalate	400		U
606-20-2	2,6-Dinitrotoluene	400		U
99-09-2	3-Nitroaniline	400		U
83-32-9	Acenaphthene	1500		
132-64-9	Dibenzofuran	970		
121-14-2	2,4-Dinitrotoluene	400		U
86-73-7	Fluorene	1300		
84-66-2	Diethylphthalate	400		U
7005-72-3	4-Chlorophenyl-phenylether	400		U
100-01-6	4-Nitroaniline	400		U
86-30-6	N-Nitrosodiphenylamine (1)	400		U
101-55-3	4-Bromophenyl-phenylether	400		U
118-74-1	Hexachlorobenzene	400		U
85-01-8	Phenanthrene	8600		E

EPA SAMPLE NO.

GFSS4

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805600

000115

Sample wt/vol: 30.2 (g/mL G

Lab File ID: P2135.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 17 decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 6.36

Concentration Units:

(ug/L or ug/Kg)

ug/Kg

O

[illegible]

(1) - Cannot be separated from Diphenylamine

Library Search Compound Report

000148

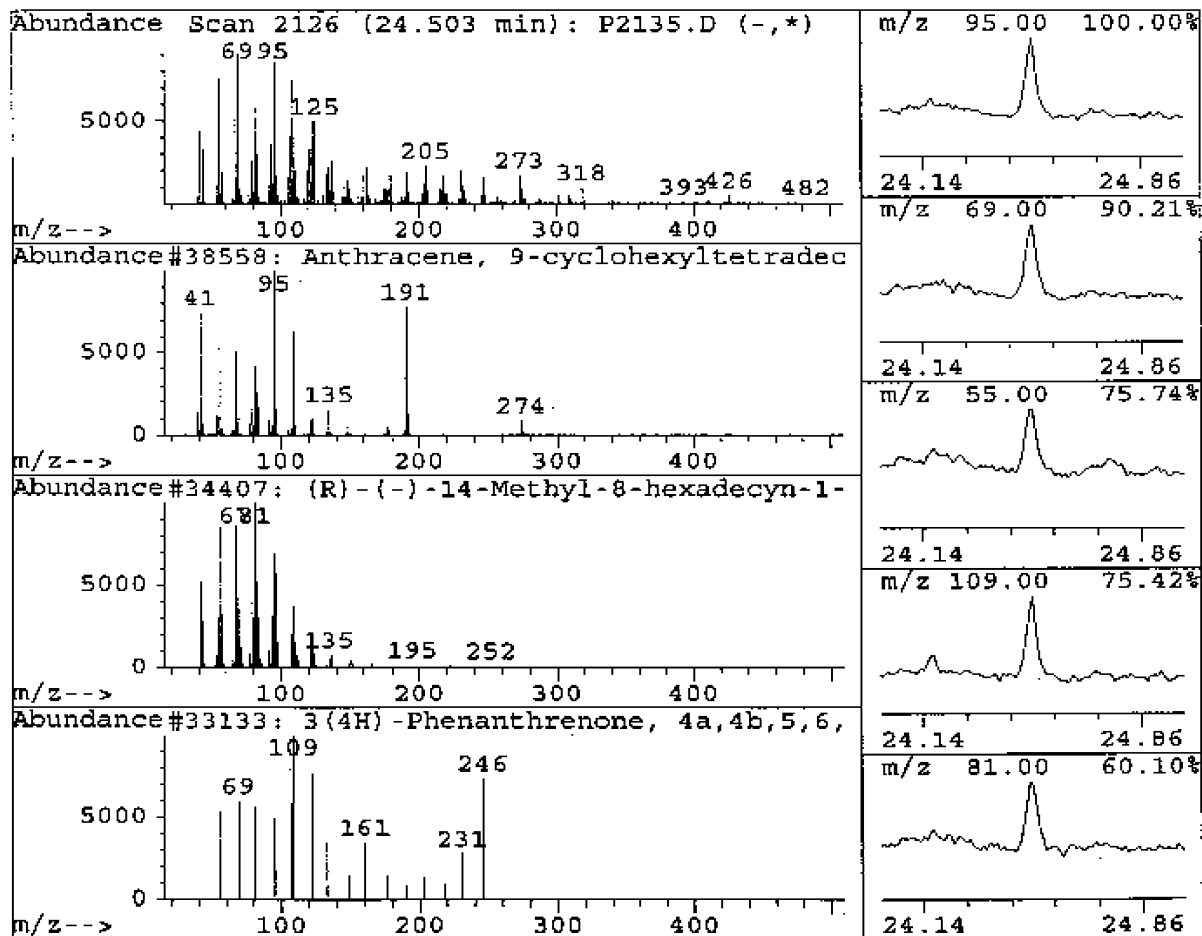
Data File : c:\hpchem\1\data\da40111.cim\p2135.d
Acq On : 11 Jan 99 8:04 pm
Sample : GGSS4
Misc : ESN:98056000

Vial: 14
Operator: CIM
Inst : 5972-DEL4
Multiplr: 1.00

Method : K:\METHODS\I40111B.M
Title : CLP BNA Calibration
Library : L:\NBS75K.L

R.T.	Conc	Area	Relative to ISTD	R.T.
24.50	8.12 ng/ μ l	909559	Perylene-d12	20.45

Hit# of 20	Tentative ID	Ref#	CAS#	Qual
1	Anthracene, 9-cyclohexyltetradecahy	38558	055255-70-4	60
2	(R)-(-)-14-Methyl-8-hexadecyn-1-ol	34407	064566-18-3	42
3	3(4H)-Phenanthrenone, 4a,4b,5,6,7,8	33133	057684-12-5	38
4	6-(3-Bromopropyl)-2(1H)-pyridinone	26462	000000-00-0	27
5	3-Octyne, 2,2,7-trimethyl-	10435	055402-13-6	25



1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

GGSS4

000116

Lab Name: DE DNREC:DIV OF WATER RES Contract: DNREC:DAWM
 Lab Code: DE023 Case No.: SAS No.: SDG No.: #6960
 Matrix: (soil/water) SOIL Lab Sample ID: 9805600
 Sample wt/vol: 30.2 (g/mL) G Lab File ID: P2135.D
 Level: (low/med) LOW Date Received: 12/7/98
 % Moisture: 17 decanted: (Y/N) N Date Extracted: 12/8/98
 Concentrated Extract Volume: 500 (uL) Date Analyzed: 1/11/99
 Injection Volume: 2.0 (uL) Dilution Factor: 1.0
 GPC Cleanup: (Y/N) Y pH: 6.4
 Concentration Units:
 Number TICs found: 22 (ug/L or ug/Kg) ug/Kg

CAS Number	Compound Name	RT	Est. Conc	Q
1.	Unknown <i>Alkylbenzenes</i>	3.22	1200	JA
2.	Unknown "	3.63	2300	JA
3.	Unknown "	4.05	1600	JA
4.	Unknown "	4.56	2500	JA
5. 90-12-0	Naphthalene, 1-methyl-	6.58	330	JN
6.	Unk C2 Naphthalene	7.39	320	J
7.	Unk C2 Naphthalene	7.53	380	J
8.	Unknown <i>C11-C22 Aromatics</i>	9.33	320	J
9.	Unk 5-Ring PAH	19.89	2000	J
10.	Unknown <i>C11-C22 Aromatics</i>	20.06	980	J
11.	Unk 5-Ring PAH	20.20	2100	J
12.	Unk 5-Ring PAH	20.52	1600	J
13.	Unknown <i>C11-C22 Aromatics</i>	20.59	460	J
14.	Unknown "	20.78	770	J
15.	Unknown "	21.26	990	J
16.	Unknown "	21.99	820	J
17.	Unk 5-Ring PAH	22.59	1100	J
18.	Unk 5-Ring PAH	22.67	1300	J
19.	Unk 6-Ring PAH	23.03	480	J
20.	Unknown ?	24.50	320	J
21.	3,4,8,9-Dibenzpyrene <i>C11-C22 Aromatics</i>	24.62	980	J
22.	[3,4,9,10]Dibenzpyrene	24.75	730	J
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGSS4DL

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805600

C00151

Sample wt/vol: 30.2 (g/mL) G

Lab File ID: P2141.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 17 decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/12/99

Injection Volume: 2.0 (uL)

Dilution Factor: 5.0

GPC Cleanup: (Y/N) Y

pH: 6.36

Concentration Units:

CAS No.	Compound	(ug/L or ug/Kg)	ug/Kg	Q
111-44-4	bis(2-Chloroethyl)ether	2000		UD
541-73-1	1,3-Dichlorobenzene	2000		UD
106-46-7	1,4-Dichlorobenzene	2000		UD
95-50-1	1,2-Dichlorobenzene	2000		UD
108-60-1	2,2'-oxybis(1-Chloropropane)	2000		UD
67-72-1	Hexachloroethane	2000		UD
621-64-7	N-Nitroso-di-n-propylamine	2000		UD
98-95-3	Nitrobenzene	2000		UD
78-59-1	Isophorone	2000		UD
111-91-1	bis(2-Chloroethoxy)methane	2000		UD
120-82-1	1,2,4-Trichlorobenzene	2000		UD
91-20-3	Naphthalene	1200		JD
106-47-8	4-Chloroaniline	2000		UD
87-68-3	Hexachlorobutadiene	2000		UD
91-57-6	2-Methylnaphthalene	830		JD
77-47-4	Hexachlorocyclopentadiene	2000		UD
91-58-7	2-Chloronaphthalene	2000		UD
88-74-4	2-Nitroaniline	2000		UD
208-96-8	Acenaphthylene	380		JD
131-11-3	Dimethylphthalate	2000		UD
606-20-2	2,6-Dinitrotoluene	2000		UD
99-09-2	3-Nitroaniline	2000		UD
83-32-9	Acenaphthene	1900		JD
132-64-9	Dibenzofuran	1200		JD
121-14-2	2,4-Dinitrotoluene	2000		UD
86-73-7	Fluorene	1600		JD
84-66-2	Diethylphthalate	2000		UD
7005-72-3	4-Chlorophenyl-phenylether	2000		UD
100-01-6	4-Nitroaniline	2000		UD
86-30-6	N-Nitrosodiphenylamine (1)	2000		UD
101-55-3	4-Bromophenyl-phenylether	2000		UD
118-74-1	Hexachlorobenzene	2000		UD
85-01-8	Phenanthrene	8200		D

EPA SAMPLE NO.

GGSS4DL

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805600

Sample wt/vol: 30.2 (g/mL G

Lab File ID: P2141.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 17

decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/12/99

Injection Volume: 2.0 (uL)

Dilution Factor: 5.0

GPC Cleanup: (Y/N) Y

pH: 6.36

Concentration Units:

[illegible]

(1) - Cannot be separated from Diphenylamine

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGTP10D

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805597

Sample wt/vol: 30.2 (g/mL) G

Lab File ID: P2132.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 16 decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.58

000195

CAS No.	Compound	Concentration Units:	
		(ug/L or ug/Kg)	ug/Kg
			Q
111-44-4	bis(2-Chloroethyl)ether	390	U
541-73-1	1,3-Dichlorobenzene	390	U
106-46-7	1,4-Dichlorobenzene	390	U
95-50-1	1,2-Dichlorobenzene	390	U
108-60-1	2,2'-oxybis(1-Chloropropane)	390	U
67-72-1	Hexachloroethane	390	U
621-64-7	N-Nitroso-di-n-propylamine	390	U
98-95-3	Nitrobenzene	390	U
78-59-1	Isophorone	390	U
111-91-1	bis(2-Chloroethoxy)methane	390	U
120-82-1	1,2,4-Trichlorobenzene	390	U
91-20-3	Naphthalene	140	J
106-47-8	4-Chloroaniline	390	U
87-68-3	Hexachlorobutadiene	390	U
91-57-6	2-Methylnaphthalene	95	J
77-47-4	Hexachlorocyclopentadiene	390	U
91-58-7	2-Chloronaphthalene	390	U
88-74-4	2-Nitroaniline	390	U
208-96-8	Acenaphthylene	180	J
131-11-3	Dimethylphthalate	390	U
606-20-2	2,6-Dinitrotoluene	390	U
99-09-2	3-Nitroaniline	390	U
83-32-9	Acenaphthene	300	J
132-64-9	Dibenzofuran	260	J
121-14-2	2,4-Dinitrotoluene	390	U
86-73-7	Fluorene	430	
84-66-2	Diethylphthalate	390	U
7005-72-3	4-Chlorophenyl-phenylether	390	U
100-01-6	4-Nitroaniline	390	U
86-30-6	N-Nitrosodiphenylamine (I)	390	U
101-55-3	4-Bromophenyl-phenylether	390	U
118-74-1	Hexachlorobenzene	390	U
85-01-8	Phenanthrene	2600	

EPA SAMPLE NO.

GGTP10D

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805597

000196

Sample wt/vol: 30.2 (g/mL G

Lab File ID: P2132.D

Level: (low/med) **LOW**

Date Received: 12/7/98

% Moisture: 16

decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 7.58

Concentration Units:

[illegible]

(1) - Cannot be separated from Diphenylamine

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

GGTP10D

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

000197
SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805597

Sample wt/vol: 30.2 (g/mL) G

Lab File ID: P2132.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 16 decanted: (Y/N) N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 7.6

Concentration Units:

Number TICs found: 22

(ug/L or ug/Kg) ug/Kg

CAS Number	Compound Name	RT	Est. Conc	Q
1.	Unknown Alkane	1.99	480	J
2.	Unknown C3 Benzene	3.20	380	J
3.	Unknown <i>Aldocondensation Product</i>	14.00	1400	<i>JA</i>
4.	Unknown "	3.60	1800	<i>JA</i>
5.	Unknown "	3.70	340	<i>JA</i>
6.	Unknown "	4.04	1700	J
7.	Unknown "	4.57	3700	J
8.	Unknown "	4.94	250	J
9.	Unk C1 3-Ring PAH <i>C11-C22</i>	<i>As 16</i>	330	J
10.	Unk 5-Ring PAH	19.72	620	J
11.	Unknown <i>C11-C22 Benzoate</i>	19.94	210	J
12.	Unk 5-Ring PAH	20.05	850	J
13.	Unknown <i>C11-C22</i>	20.61	260	J
14.	Unknown "	21.11	200	J
15.	Unknown Alkane	21.45	280	J
16.	Unk 5-Ring PAH <i>C11-C22 Benzoate</i>	22.05	530	J
17.	Unk 5-Ring PAH	22.43	390	J
18.	Unk 5-Ring PAH	22.49	400	J
19.	Unk 6-Ring PAH	22.86	320	J
20.	1,2:4,5-Dibenzpyrene	24.49	850	J
21.	1,2:3,4-Dibenzpyrene	24.63	510	J
22.	Unknown <i>Alkane</i>	24.72	450	J
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGTP10DDL

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805597

000232

Sample wt/vol: 30.2 (g/mL G)

Lab File ID: P2143.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 16

decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/12/99

Injection Volume: 2.0 (uL)

Dilution Factor: 2.0

GPC Cleanup: (Y/N) Y

pH: 7.58

Concentration Units:

CAS No.	Compound	(ug/L or ug/Kg)	ug/Kg	Q
111-44-4	bis(2-Chloroethyl)ether	790		UD
541-73-1	1,3-Dichlorobenzene	790		UD
106-46-7	1,4-Dichlorobenzene	790		UD
95-50-1	1,2-Dichlorobenzene	790		UD
108-60-1	2,2'-oxybis(1-Chloropropane)	790		UD
67-72-1	Hexachloroethane	790		UD
621-64-7	N-Nitroso-di-n-propylamine	790		UD
98-95-3	Nitrobenzene	790		UD
78-59-1	Isophorone	790		UD
111-91-1	bis(2-Chloroethoxy)methane	790		UD
120-82-1	1,2,4-Trichlorobenzene	790		UD
91-20-3	Naphthalene	130		JD
106-47-8	4-Chloroaniline	790		UD
87-68-3	Hexachlorobutadiene	790		UD
91-57-6	2-Methylnaphthalene	92		JD
77-47-4	Hexachlorocyclopentadiene	790		UD
91-58-7	2-Chloronaphthalene	790		UD
88-74-4	2-Nitroaniline	790		UD
208-96-8	Acenaphthylene	190		JD
131-11-3	Dimethylphthalate	790		UD
606-20-2	2,6-Dinitrotoluene	790		UD
99-09-2	3-Nitroaniline	790		UD
83-32-9	Acenaphthene	310		JD
132-64-9	Dibenzofuran	270		JD
121-14-2	2,4-Dinitrotoluene	790		UD
86-73-7	Fluorene	430		JD
84-66-2	Diethylphthalate	790		UD
7005-72-3	4-Chlorophenyl-phenylether	790		UD
100-01-6	4-Nitroaniline	790		UD
86-30-6	N-Nitrosodiphenylamine (1)	790		UD
101-55-3	4-Bromophenyl-phenylether	790		UD
118-74-1	Hexachlorobenzene	790		UD
85-01-8	Phenanthrene	2400		D

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGTP2D

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805589

Sample wt/vol: 30.1 (g/mL G)

Lab File ID: P2131.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 17 decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 5.65

Concentration Units:

CAS No.	Compound	(ug/L or ug/Kg)	ug/Kg	Q
111-44-4	bis(2-Chloroethyl)ether	400		U
541-73-1	1,3-Dichlorobenzene	400		U
106-46-7	1,4-Dichlorobenzene	400		U
95-50-1	1,2-Dichlorobenzene	400		U
108-60-1	2,2'-oxybis(1-Chloropropane)	400		U
67-72-1	Hexachloroethane	400		U
621-64-7	N-Nitroso-di-n-propylamine	400		U
98-95-3	Nitrobenzene	400		U
78-59-1	Isophorone	400		U
111-91-1	bis(2-Chloroethoxy)methane	400		U
120-82-1	1,2,4-Trichlorobenzene	400		U
91-20-3	Naphthalene	400		U
106-47-8	4-Chloroaniline	400		U
87-68-3	Hexachlorobutadiene	400		U
91-57-6	2-Methylnaphthalene	400		U
77-47-4	Hexachlorocyclopentadiene	400		U
91-58-7	2-Chloronaphthalene	400		U
88-74-4	2-Nitroaniline	400		U
208-96-8	Acenaphthylene	400		U
131-11-3	Dimethylphthalate	400		U
606-20-2	2,6-Dinitrotoluene	400		U
99-09-2	3-Nitroaniline	400		U
83-32-9	Acenaphthene	400		U
132-64-9	Dibenzofuran	400		U
121-14-2	2,4-Dinitrotoluene	400		U
86-73-7	Fluorene	400		U
84-66-2	Diethylphthalate	400		U
7005-72-3	4-Chlorophenyl-phenylether	400		U
100-01-6	4-Nitroaniline	400		U
86-30-6	N-Nitrosodiphenylamine (1)	400		U
101-55-3	4-Bromophenyl-phenylether	400		U
118-74-1	Hexachlorobenzene	400		U
85-01-8	Phenanthrene	400		U

000269

EPA SAMPLE NO.

GGTP2D

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.:

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805589

000270

Sample wt/vol: 30.1 (g/mL **G**)

Lab File ID: P2131.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 17

decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 5.65

Concentration Units:

[illegible]

(1) - Cannot be separated from Diphenylamine

Library Search Compound Report

000279

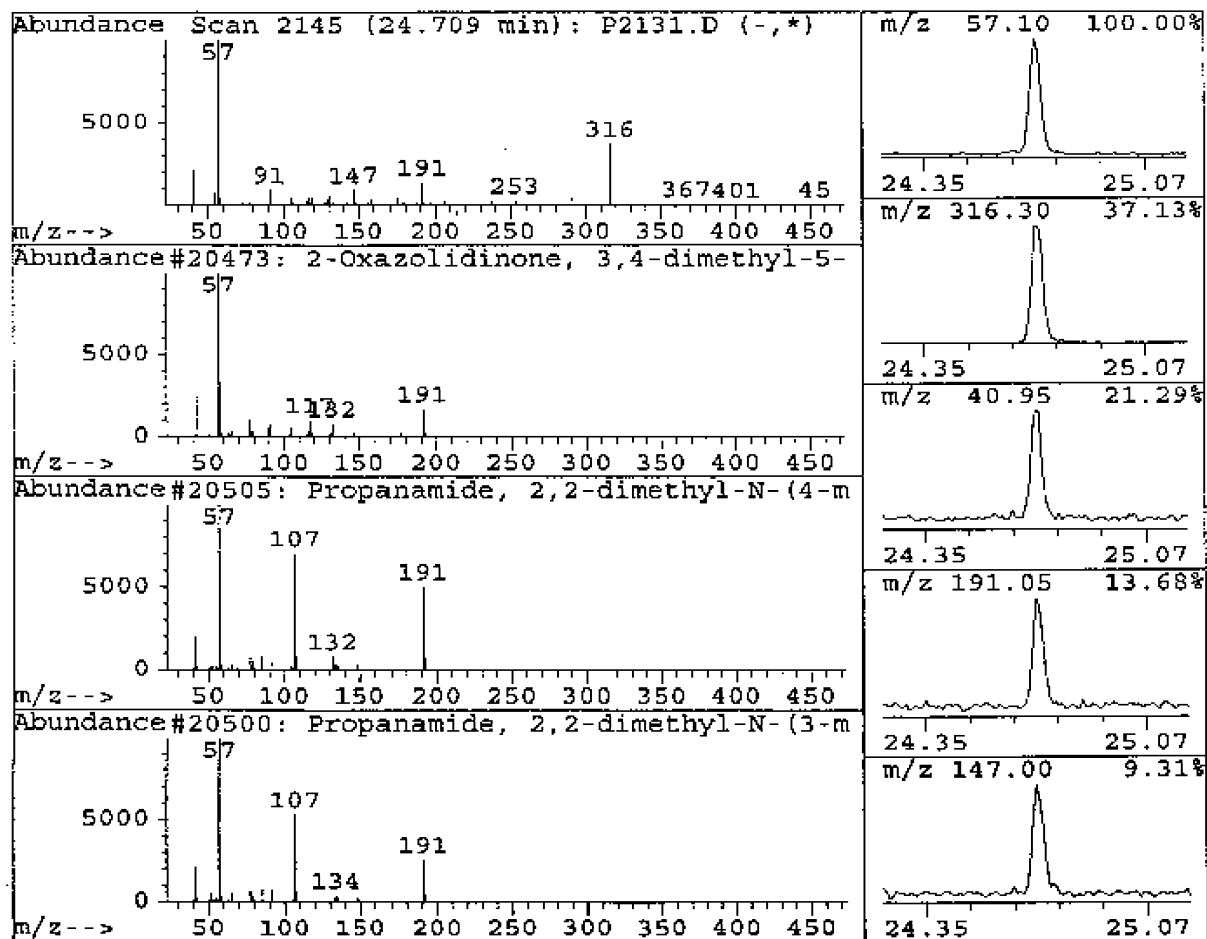
Data File : C:\HPCHEM\1\DATA\DA40111.CIM\P2131.D
Acq On : 11 Jan 99 5:54 pm
Sample : GGTP2D
Misc : ESN:98055890

Vial: 10
Operator: CIM
Inst : 5972-DEL4
Multiplr: 1.00

Method : K:\METHODS\I40111B.M
Title : CLP BNA Calibration
Library : L:\NBS75K.L

R.T.	Conc	Area	Relative to ISTD	R.T.
24.71	3.17 ng/ μ l	348169	Perylene-d12	20.23

Hit# of 20	Tentative ID	Ref#	CAS#	Qual
1	2-Oxazolidinone, 3,4-dimethyl-5-phe	20473	032461-37-3	9
2	Propanamide, 2,2-dimethyl-N-(4-meth	20505	021354-40-5	9
3	Propanamide, 2,2-dimethyl-N-(3-meth	20500	032597-29-8	9
4	2-Propen-1-amine	87	000107-11-9	3
5	Azetidine	83	000503-29-7	2



1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

GGTP2D

000271

Lab Name: DE DNREC:DIV OF WATER RES Contract: DNREC:DAWM
 Lab Code: DE023 Case No.: _____ SAS No.: _____ SDG No.: #6960
 Matrix: (soil/water) SOIL Lab Sample ID: 9805589
 Sample wt/vol: 30.1 (g/mL) G Lab File ID: P2131.D
 Level: (low/med) LOW Date Received: 12/7/98
 % Moisture: 17 decanted: (Y/N) N Date Extracted: 12/8/98
 Concentrated Extract Volume: 500 (uL) Date Analyzed: 1/11/99
 Injection Volume: 2.0 (uL) Dilution Factor: 1.0
 GPC Cleanup: (Y/N) Y pH: 5.7
 Concentration Units: _____
 Number TICs found: 5 (ug/L or ug/Kg) ug/Kg

CAS Number	Compound Name	RT	Est. Conc	Q
1.	Unknown Alkane	1.98	440	J
2.	Unknown <i>Cyclo Alkane</i>	2.76	160	J
3.	Unknown C3 Benzene	3.20	340	J
4.	Unknown <i>Alkyl condensation</i>	3.5	420	J A
5.	Unknown ?	24.71	130	J
6.				
7.				
8.				
9.				
10.				
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12.				
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1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGTP3S

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805590

000280

Sample wt/vol: 30.2 (g/mL) G

Lab File ID: P2147.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 15

decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/12/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 7.01

Concentration Units:

CAS No.	Compound	(ug/L or ug/Kg)	ug/Kg	Q
111-44-4	bis(2-Chloroethyl)ether	390		U
541-73-1	1,3-Dichlorobenzene	390		U
106-46-7	1,4-Dichlorobenzene	390		U
95-50-1	1,2-Dichlorobenzene	390		U
108-60-1	2,2'-oxybis(1-Chloropropane)	390		U
67-72-1	Hexachloroethane	390		U
621-64-7	N-Nitroso-di-n-propylamine	390		U
98-95-3	Nitrobenzene	390		U
78-59-1	Isophorone	390		U
111-91-1	bis(2-Chloroethoxy)methane	390		U
120-82-1	1,2,4-Trichlorobenzene	390		U
91-20-3	Naphthalene	130		J
106-47-8	4-Chloroaniline	390		U
87-68-3	Hexachlorobutadiene	390		U
91-57-6	2-Methylnaphthalene	83		J
77-47-4	Hexachlorocyclopentadiene	390		U
91-58-7	2-Chloronaphthalene	390		U
88-74-4	2-Nitroaniline	390		U
208-96-8	Acenaphthylene	170		J
131-11-3	Dimethylphthalate	390		U
606-20-2	2,6-Dinitrotoluene	390		U
99-09-2	3-Nitroaniline	390		U
83-32-9	Acenaphthene	840		
132-64-9	Dibenzofuran	710		
121-14-2	2,4-Dinitrotoluene	390		U
86-73-7	Fluorene	1200		
84-66-2	Diethylphthalate	390		U
7005-72-3	4-Chlorophenyl-phenylether	390		U
100-01-6	4-Nitroaniline	390		U
86-30-6	N-Nitrosodiphenylamine (1)	390		U
101-55-3	4-Bromophenyl-phenylether	390		U
118-74-1	Hexachlorobenzene	390		U
85-01-8	Phenanthrene	11000		E

EPA SAMPLE NO.

GGTP3S

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805590

000281

Sample wt/vol: 30.2 (g/mL G

Lab File ID: P2147.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 15

decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/12/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 7.01

Concentration Units:

[illegible]

(1) - Cannot be separated from Diphenylamine

IF
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

GGTP3S

000282

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805590

Sample wt/vol: 30.2 (g/mL) G

Lab File ID: P2147.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 15 decanted: (Y/N) N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/12/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 7.0

Concentration Units:

Number TICs found: 22

(ug/L or ug/Kg) ug/Kg

CAS Number	Compound Name	RT	Est. Conc	Q
1.	Unknown Alkane	1.87	230	J
2.	Unknown C3 Benzene	3.15	290	J
3.	Unknown <i>Aldehyde C15-010</i>	3.56	1700	J <i>A</i>
4.	Unknown "	3.56	1700	J <i>A</i>
5.	Unknown "	3.65	250	J <i>A</i>
6.	Unknown "	4.01	1600	J "
7.	Unknown "	4.53	5300	J "
8.	Unknown	4.93	290	J
9. 644-08-6	1,1'-Biphenyl, 4-methyl- <i>CR-C2</i>	8.28	250	JN
10. 7320-53-8	Dibenzofuran, 4-methyl- <i>CR-C2</i>	9.47	320	JN
11.	Unk C1 4-Ring PAH	15.19	420	J
12.	Unk 5-Ring PAH	19.92	790	J
13.	Unknown "	20.07	360	J
14.	Unk 5-Ring PAH	20.19	820	J
15.	Unk 5-Ring PAH	20.57	780	J
16.	Unknown "	20.78	230	J
17.	Unknown "	21.28	460	J
18.	Unk 5-Ring PAH	22.63	370	J
19.	1,2:7,8-Dibenzphenanthrene "	22.70	720	J
20.	Unk 6-Ring PAH	22.85	600	J
21.	Unknown "	23.64	240	J
22.	1,2:3,4-Dibenzpyrene	24.61	780	J
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGTP3SDL

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805590

Sample wt/vol: 30.2 (g/mL) G

Lab File ID: P2140.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 15 decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/12/99

Injection Volume: 2.0 (uL)

Dilution Factor: 10.0

GPC Cleanup: (Y/N) Y

pH: 7.01

Concentration Units:

CAS No.	Compound	(ug/L or ug/Kg)	ug/Kg	Q
111-44-4	bis(2-Chloroethyl)ether	3900		UD
541-73-1	1,3-Dichlorobenzene	3900		UD
106-46-7	1,4-Dichlorobenzene	3900		UD
95-50-1	1,2-Dichlorobenzene	3900		UD
108-60-1	2,2'-oxybis(1-Chloropropane)	3900		UD
67-72-1	Hexachloroethane	3900		UD
621-64-7	N-Nitroso-di-n-propylamine	3900		UD
98-95-3	Nitrobenzene	3900		UD
78-59-1	Isophorone	3900		UD
111-91-1	bis(2-Chloroethoxy)methane	3900		UD
120-82-1	1,2,4-Trichlorobenzene	3900		UD
91-20-3	Naphthalene	120		JD
106-47-8	4-Chloroaniline	3900		UD
87-68-3	Hexachlorobutadiene	3900		UD
91-57-6	2-Methylnaphthalene	82		JD
77-47-4	Hexachlorocyclopentadiene	3900		UD
91-58-7	2-Chloronaphthalene	3900		UD
88-74-4	2-Nitroaniline	3900		UD
208-96-8	Acenaphthylene	140		JD
131-11-3	Dimethylphthalate	3900		UD
606-20-2	2,6-Dinitrotoluene	3900		UD
99-09-2	3-Nitroaniline	3900		UD
83-32-9	Acenaphthene	860		JD
132-64-9	Dibenzofuran	710		JD
121-14-2	2,4-Dinitrotoluene	3900		UD
86-73-7	Fluorene	1200		JD
84-66-2	Diethylphthalate	3900		UD
7005-72-3	4-Chlorophenyl-phenylether	3900		UD
100-01-6	4-Nitroaniline	3900		UD
86-30-6	N-Nitrosodiphenylamine (1)	3900		UD
101-55-3	4-Bromophenyl-phenylether	3900		UD
118-74-1	Hexachlorobenzene	3900		UD
85-01-8	Phenanthrene	10000		D

000323

EPA SAMPLE NO.

GGTP3SDL

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805590

000324

Sample wt/vol: 30.2 (g/mL G

Lab File ID: P2140.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 15

decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/12/99

Injection Volume: 2.0 (uL)

Dilution Factor: 10.0

GPC Cleanup: (Y/N) Y

pH: 7.01

Concentration Units:

(ug/L or ug/Kg)

ug/Kg

0

[illegible]

(1) - Cannot be separated from Diphenylamine

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGTPSS

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805593

000360

Sample wt/vol: 30.2 (g/mL) G

Lab File ID: P2136.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 16

decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 5.99

Concentration Units:

CAS No.	Compound	(ug/L or ug/Kg)	ug/Kg	Q
111-44-4	bis(2-Chloroethyl)ether	390		U
541-73-1	1,3-Dichlorobenzene	390		U
106-46-7	1,4-Dichlorobenzene	390		U
95-50-1	1,2-Dichlorobenzene	390		U
108-60-1	2,2'-oxybis(1-Chloropropane)	390		U
67-72-1	Hexachloroethane	390		U
621-64-7	N-Nitroso-di-n-propylamine	390		U
98-95-3	Nitrobenzene	390		U
78-59-1	Isophorone	390		U
111-91-1	bis(2-Chloroethoxy)methane	390		U
120-82-1	1,2,4-Trichlorobenzene	390		U
91-20-3	Naphthalene	390		U
106-47-8	4-Chloroaniline	390		U
87-68-3	Hexachlorobutadiene	390		U
91-57-6	2-Methylnaphthalene	390		U
77-47-4	Hexachlorocyclopentadiene	390		U
91-58-7	2-Chloronaphthalene	390		U
88-74-4	2-Nitroaniline	390		U
208-96-8	Acenaphthylene	51		J
131-11-3	Dimethylphthalate	390		U
606-20-2	2,6-Dinitrotoluene	390		U
99-09-2	3-Nitroaniline	390		U
83-32-9	Acenaphthene	390		U
132-64-9	Dibenzofuran	390		U
121-14-2	2,4-Dinitrotoluene	390		U
86-73-7	Fluorene	20		J
84-66-2	Diethylphthalate	390		U
7005-72-3	4-Chlorophenyl-phenylether	390		U
100-01-6	4-Nitroaniline	390		U
86-30-6	N-Nitrosodiphenylamine (1)	390		U
101-55-3	4-Bromophenyl-phenylether	390		U
118-74-1	Hexachlorobenzene	390		U
85-01-8	Phenanthrene	290		J

EPA SAMPLE NO.

GGTP5S

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805593

Sample wt/vol: 30.2 (g/mL G

Lab File ID: P2136.D

Level: (low/med) **LOW**

Date Received: 12/7/98

% Moisture: 16 decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 5.99

Concentration Units:

(ug/L or ug/Kg)

ug/Kg

[illegible]

(1) - Cannot be separated from Diphenylamine

Library Search Compound Report

000394

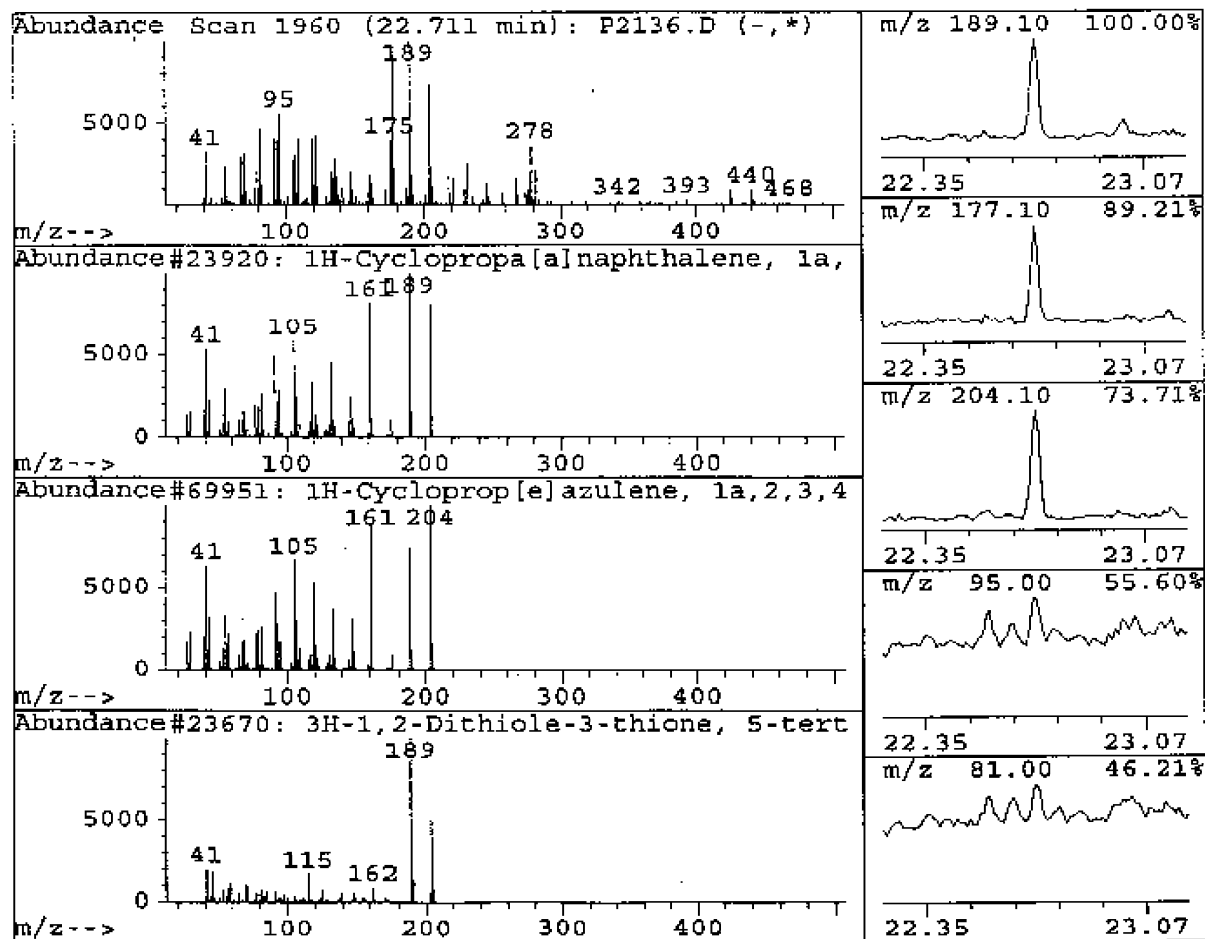
Data File : c:\hpchem\1\data\da40111.cim\p2136.d
Acq On : 11 Jan 99 8:36 pm
Sample : GGTP5S
Misc : ESN:98055930

Vial: 15
Operator: CIM
Inst : 5972-DEL4
Multiplr: 1.00

Method : K:\METHODS\I40111B.M
Title : CLP BNA Calibration
Library : L:\NBS75K.L

R.T.	Conc	Area	Relative to ISTD	R.T.
22.71	3.15 ng/ μ l	371329	Perylene-d12	20.27

Hit# of 20	Tentative ID	Ref#	CAS#	Qual
1	1H-Cyclopropa[a]naphthalene, 1a,2,3	23920	000489-29-2	43
2	1H-Cycloprop[e]azulene, 1a,2,3,4,4a	69951	000489-40-7	30
3	3H-1,2-Dithiole-3-thione, 5-tert-bu	23670	013120-76-8	27
4	Naphthalene, 1,2,4a,5,8,8a-hexahydr	69920	005951-61-1	27
5	Naphthalene, 1,2,3,5,6,7,8,8a-octah	69888	004630-07-3	20



1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

GGTPSS

000362

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805593

Sample wt/vol: 30.2 (g/mL) G

Lab File ID: P2136.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 16 decanted: (Y/N) N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 6.0

Concentration Units:

Number TICs found: 21

(ug/L or ug/Kg) ug/Kg

CAS Number	Compound Name	RT	Est. Conc	Q
1.	Unknown Alkane	1.97	380	J
2.	Unknown C3 Benzene	3.20	290	J
3.	Unknown <i>Alkane 27.100</i>	3.59	1200	J A
4.	Unknown "	3.88	130	J A
5.	Unknown "	4.03	1300	J A
6.	Unknown "	4.23	170	J
7.	Unknown "	4.47	270	J
8.	Unknown "	4.56	3300	J A
9.	Unknown "	4.94	330	J A
10.	Unknown "			
11. 57-10-3	Hexadecanoic acid	12.71	460	JN
12. 57-11-4	Octadecanoic acid	14.53	250	JN
13.	Unk C1 3-Ring PAH	15.13	260	J
14.	Unknown <i>C11-C22 Aromatics</i>	16.64	190	J
15.	Unknown "	16.74	140	J
16.	Unk C1 4-Ring PAH	18.09	120	J
17.	Unk 5-Ring PAH	19.71	220	J
18.	Unk 5-Ring PAH	20.03	400	J
19.	Unknown Alkane	21.45	180	J
20.	Unk 6-Ring PAH <i>C11-C22 Aromatics</i>	22.05	210	J
21.	Unknown ?	22.71	120	J
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGTP6S

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805594

Sample wt/vol: 30.3 (g/mL) G

Lab File ID: P2137.D

000395

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 8 decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 7.63

Concentration Units:

CAS No.	Compound	(ug/L or ug/Kg)	ug/Kg	Q
111-44-4	bis(2-Chloroethyl)ether	360		U
541-73-1	1,3-Dichlorobenzene	360		U
106-46-7	1,4-Dichlorobenzene	360		U
95-50-1	1,2-Dichlorobenzene	360		U
108-60-1	2,2'-oxybis(1-Chloropropane)	360		U
67-72-1	Hexachloroethane	360		U
621-64-7	N-Nitroso-di-n-propylamine	360		U
98-95-3	Nitrobenzene	360		U
78-59-1	Isophorone	360		U
111-91-1	bis(2-Chloroethoxy)methane	360		U
120-82-1	1,2,4-Trichlorobenzene	360		U
91-20-3	Naphthalene	170		J
106-47-8	4-Chloroaniline	360		U
87-68-3	Hexachlorobutadiene	360		U
91-57-6	2-Methylnaphthalene	110		J
77-47-4	Hexachlorocyclopentadiene	360		U
91-58-7	2-Chloronaphthalene	360		U
88-74-4	2-Nitroaniline	360		U
208-96-8	Acenaphthylene	160		J
131-11-3	Dimethylphthalate	360		U
606-20-2	2,6-Dinitrotoluene	360		U
99-09-2	3-Nitroaniline	360		U
83-32-9	Acenaphthene	240		J
132-64-9	Dibenzofuran	190		J
121-14-2	2,4-Dinitrotoluene	360		U
86-73-7	Fluorene	250		J
84-66-2	Diethylphthalate	360		U
7005-72-3	4-Chlorophenyl-phenylether	360		U
100-01-6	4-Nitroaniline	360		U
86-30-6	N-Nitrosodiphenylamine (1)	360		U
101-55-3	4-Bromophenyl-phenylether	360		U
118-74-1	Hexachlorobenzene	360		U
85-01-8	Phenanthrene	2000		

EPA SAMPLE NO.

GGTP65

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805594

000396

Sample wt/vol: 30.3 (g/mL G

Lab File ID: P2137.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 8

decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 7.63

Concentration Units:

[illegible]

(1) - Cannot be separated from Diphenylamine

Library Search Compound Report

000431

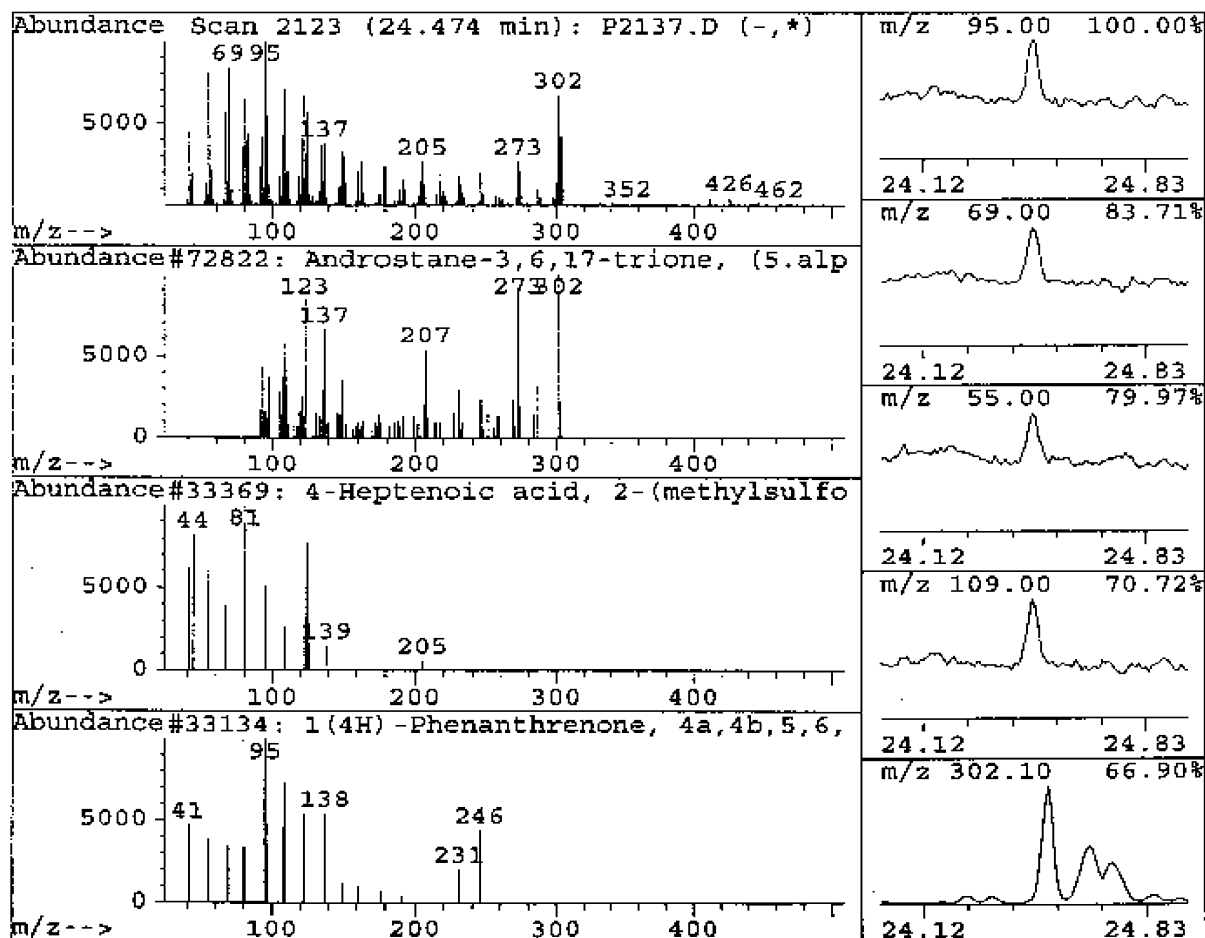
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Acq On : 11 Jan 99 9:08 pm
Sample : GGTP6S
Misc : ESN:98055940

Vial: 16
Operator: CIM
Inst : 5972-DEL4
Multiplr: 1.00

Method : K:\METHODS\I40111B.M
Title : CLP BNA Calibration
Library : L:\NBS75K.L

R.T.	Conc	Area	Relative to ISTD	R.T.
24.47	6.66 ng/ μ l	967860	Perylene-d12	20.30

Hit# of 20	Tentative ID	Ref#	CAS#	Qual
1	Androstane-3,6,17-trione, (5.alpha.)	72822	002243-05-2	22
2	4-Heptenoic acid, 2-(methylsulfonyl	33369	067428-09-5	16
3	1(4H)-Phenanthrenone, 4a,4b,5,6,7,8	33134	057684-15-8	16
4	Pregnan-3-one, (5.alpha.)-	43210	014778-11-1	12
5	Androstane-3,12,17-trione, (5.beta.)	43121	053604-37-8	12



1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

GGTP6S

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

000397

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805594

Sample wt/vol: 30.3 (g/mL) G

Lab File ID: P2137.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 8 decanted: (Y/N) N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 7.6

Concentration Units:

Number TICs found: 22

(ug/L or ug/Kg) ug/Kg

CAS Number	Compound Name	RT	Est. Conc	Q
1.	Unknown <i>10,10-dibenzanthracene</i>	3.37	1500	J A
2.	Unknown "	3.61	1500	J A
3.	Unknown "	3.70	250	J A
4.	Unknown "	4.03	610	J A
5.	Unknown "	4.56	1800	J A
6.	Unknown "	4.94	210	J A
7. 486-25-9	9H-Fluoren-9-one	10.69	330	JN
8. 544-63-8	Tetradecanoic acid	10.75	230	JN
9. 132-65-0	Dibenzothiophene	10.84	250	JN
10.	Unk C1 3-Ring PAH	12.22	400	J
11.	Unk C1 3-Ring PAH	12.29	420	J
12.	Unknown <i>C11-C22 Aromatic</i>	12.46	520	J
13.	Unk C1 3-Ring PAH	12.52	200	J
14.	Unknown <i>C11-C22 Aromatic</i>	12.95	320	J
15. 84-65-1	9,10-Anthracenedione	12.98	330	JN
16.	Unk C1 4-Ring PAH	15.15	240	J
17.	Unknown <i>C11-C22 Aromatic</i>	16.65	210	J
18.	Unk 5-Ring PAH	19.75	680	J
19.	Unk 5-Ring PAH	20.10	810	J
20.	Unk 5-Ring PAH	20.36	270	J
21.	Unk 5-Ring PAH	22.09	290	J
22.	Unknown ?	24.47	240	J
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGTP6SDL

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805594

000432

Sample wt/vol: 30.3 (g/mL) G

Lab File ID: P2148.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 8

decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/12/99

Injection Volume: 2.0 (uL)

Dilution Factor: 2.0

GPC Cleanup: (Y/N) Y

pH: 7.63

Concentration Units:

CAS No.	Compound	(ug/L or ug/Kg)	ug/Kg	Q
111-44-4	bis(2-Chloroethyl)ether	720		UD
541-73-1	1,3-Dichlorobenzene	720		UD
106-46-7	1,4-Dichlorobenzene	720		UD
95-50-1	1,2-Dichlorobenzene	720		UD
108-60-1	2,2'-oxybis(1-Chloropropane)	720		UD
67-72-1	Hexachloroethane	720		UD
621-64-7	N-Nitroso-di-n-propylamine	720		UD
98-95-3	Nitrobenzene	720		UD
78-59-1	Isophorone	720		UD
111-91-1	bis(2-Chloroethoxy)methane	720		UD
120-82-1	1,2,4-Trichlorobenzene	720		UD
91-20-3	Naphthalene	190		JD
106-47-8	4-Chloroaniline	720		UD
87-68-3	Hexachlorobutadiene	720		UD
91-57-6	2-Methylnaphthalene	120		JD
77-47-4	Hexachlorocyclopentadiene	720		UD
91-58-7	2-Chloronaphthalene	720		UD
88-74-4	2-Nitroaniline	720		UD
208-96-8	Acenaphthylene	190		JD
131-11-3	Dimethylphthalate	720		UD
606-20-2	2,6-Dinitrotoluene	720		UD
99-09-2	3-Nitroaniline	720		UD
83-32-9	Acenaphthene	270		JD
132-64-9	Dibenzofuran	210		JD
121-14-2	2,4-Dinitrotoluene	720		UD
86-73-7	Fluorene	280		JD
84-66-2	Diethylphthalate	720		UD
7005-72-3	4-Chlorophenyl-phenylether	720		UD
100-01-6	4-Nitroaniline	720		UD
86-30-6	N-Nitrosodiphenylamine (1)	720		UD
101-55-3	4-Bromophenyl-phenylether	720		UD
118-74-1	Hexachlorobenzene	720		UD
85-01-8	Phenanthrene	2200		D

EPA SAMPLE NO.

GGTP6SDL

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805594

000433

Sample wt/vol: 30.3 (g/mL G

Lab File ID: P2148.D

Level: (low/med) **LOW**

Date Received: 12/7/98

% Moisture: 8 decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/12/99

Injection Volume: 2.0 (uL)

Dilution Factor: 2.0

GPC Cleanup: (Y/N) Y

pH: 7.63

Concentration Units:

(ug/L or ug/Kg)

 μ_B/K_B

Q

[illegible]

(1) - Cannot be separated from Diphenylamine

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

GGTP9S

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.: _____

SAS No.: _____

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805595

Sample wt/vol: 30.7 (g/mL) G

Lab File ID: P2138.D

Level: (low/med) LOW

Date Received: 12/7/98

% Moisture: 10

decanted: (Y/N): N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 7.34

Concentration Units:

CAS No.	Compound	(ug/L or ug/Kg)	ug/Kg	Q
111-44-4	bis(2-Chloroethyl)ether	360		U
541-73-1	1,3-Dichlorobenzene	360		U
106-46-7	1,4-Dichlorobenzene	360		U
95-50-1	1,2-Dichlorobenzene	360		U
108-60-1	2,2'-oxybis(1-Chloropropane)	360		U
67-72-1	Hexachloroethane	360		U
621-64-7	N-Nitroso-di-n-propylamine	360		U
98-95-3	Nitrobenzene	360		U
78-59-1	Isophorone	360		U
111-91-1	bis(2-Chloroethoxy)methane	360		U
120-82-1	1,2,4-Trichlorobenzene	360		U
91-20-3	Naphthalene	120		J
106-47-8	4-Chloroaniline	360		U
87-68-3	Hexachlorobutadiene	360		U
91-57-6	2-Methylnaphthalene	75		J
77-47-4	Hexachlorocyclopentadiene	360		U
91-58-7	2-Chloronaphthalene	360		U
88-74-4	2-Nitroaniline	360		U
208-96-8	Acenaphthylene	210		J
131-11-3	Dimethylphthalate	360		U
606-20-2	2,6-Dinitrotoluene	360		U
99-09-2	3-Nitroaniline	360		U
83-32-9	Acenaphthene	150		J
132-64-9	Dibenzofuran	160		J
121-14-2	2,4-Dinitrotoluene	360		U
86-73-7	Fluorene	200		J
84-66-2	Diethylphthalate	360		U
7005-72-3	4-Chlorophenyl-phenylether	360		U
100-01-6	4-Nitroaniline	360		U
86-30-6	N-Nitrosodiphenylamine (1)	360		U
101-55-3	4-Bromophenyl-phenylether	360		U
118-74-1	Hexachlorobenzene	360		U
85-01-8	Phenanthrene	1700		

CC0469

EPA SAMPLE NO.

GGTP9S

Lab Name: DE DNREC:DIV OF WATER RES

Contract: DNREC:DAWM

Lab Code: DE023

Case No.:

SAS No.:

SDG No.: #6960

Matrix: (soil/water) SOIL

Lab Sample ID: 9805595

000470

Sample wt/vol: 30.7 (g/mL G

Lab File ID: P2138.D

Level: (low/med) **LOW**

Date Received: 12/7/98

% Moisture: 10

decanted: (Y/N); N

Date Extracted: 12/8/98

Concentrated Extract Volume: 500 (uL)

Date Analyzed: 1/11/99

Injection Volume: 2.0 (uL)

Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y

pH: 7.34

Concentration Units:

(ug/L or ug/Kg)

 $\mu\text{g/Kg}$

Q

[illegible]

(1) - Cannot be separated from Diphenylamine

IF
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

GGT99S

000471

Lab Name: DE DNREC:DIV OF WATER RES Contract: DNREC:DAWM
 Lab Code: DE023 Case No.: SAS No.: SDG No.: #6960
 Matrix: (soil/water) SOIL Lab Sample ID: 9805595
 Sample wt/vol: 30.7 (g/mL) G Lab File ID: P2138.D
 Level: (low/med) LOW Date Received: 12/7/98
 % Moisture: 10 decanted: (Y/N) N Date Extracted: 12/8/98
 Concentrated Extract Volume: 500 (uL) Date Analyzed: 1/11/99
 Injection Volume: 2.0 (uL) Dilution Factor: 1.0
 GPC Cleanup: (Y/N) Y pH: 7.3
 Concentration Units:
 Number TICs found: 22 (ug/L or ug/Kg) ug/Kg

CAS Number	Compound Name	RT	Est. Conc	Q
1.	Unknown Alkane	1.98	300	J
2.	Unknown C3 Benzene	3.20	230	J
3.	Unknown <i>Abelardous A.T.</i>	3.60	1100	J <i>A</i>
4.	Unknown "	4.04	940	J <i>A</i>
5.	Unknown "	4.55	1900	J <i>A</i>
6.	Unknown "	4.94	230	J <i>A</i>
8. 486-25-9	9H-Fluoren-9-one <i>C11-C22</i>	10.70	290	JN
9. 132-65-0	Dibenzothiophene	10.84	210	JN
10.	Unk C1 3-Ring PAH <i>C11-C22</i>	12.29	210	J
11.	Unk C1 3-Ring PAH "	12.47	360	J
12.	Unk C1 3-Ring PAH "	12.98	520	JN
13. 84-65-1	9,10-Anthracenedione	13.69	290	JN
14. 5737-13-3	Cyclopenta(def)phenanthrenon	15.15	220	J
15.	Unk C1 4-Ring PAH "	19.74	580	J
16.	Unk 5-Ring PAH "	20.08	760	J
17.	Unk 5-Ring PAH "	21.45	240	J
18.	Unknown Alkane	21.45	240	J
19.	Unk 5-Ring PAH <i>C11-C22</i>	22.44	330	J
20.	Unk 5-Ring PAH "	22.51	200	J
21.	Unk 5-Ring PAH "	24.47	210	J
22.	1,2,4,5-Dibenzpyrene			
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

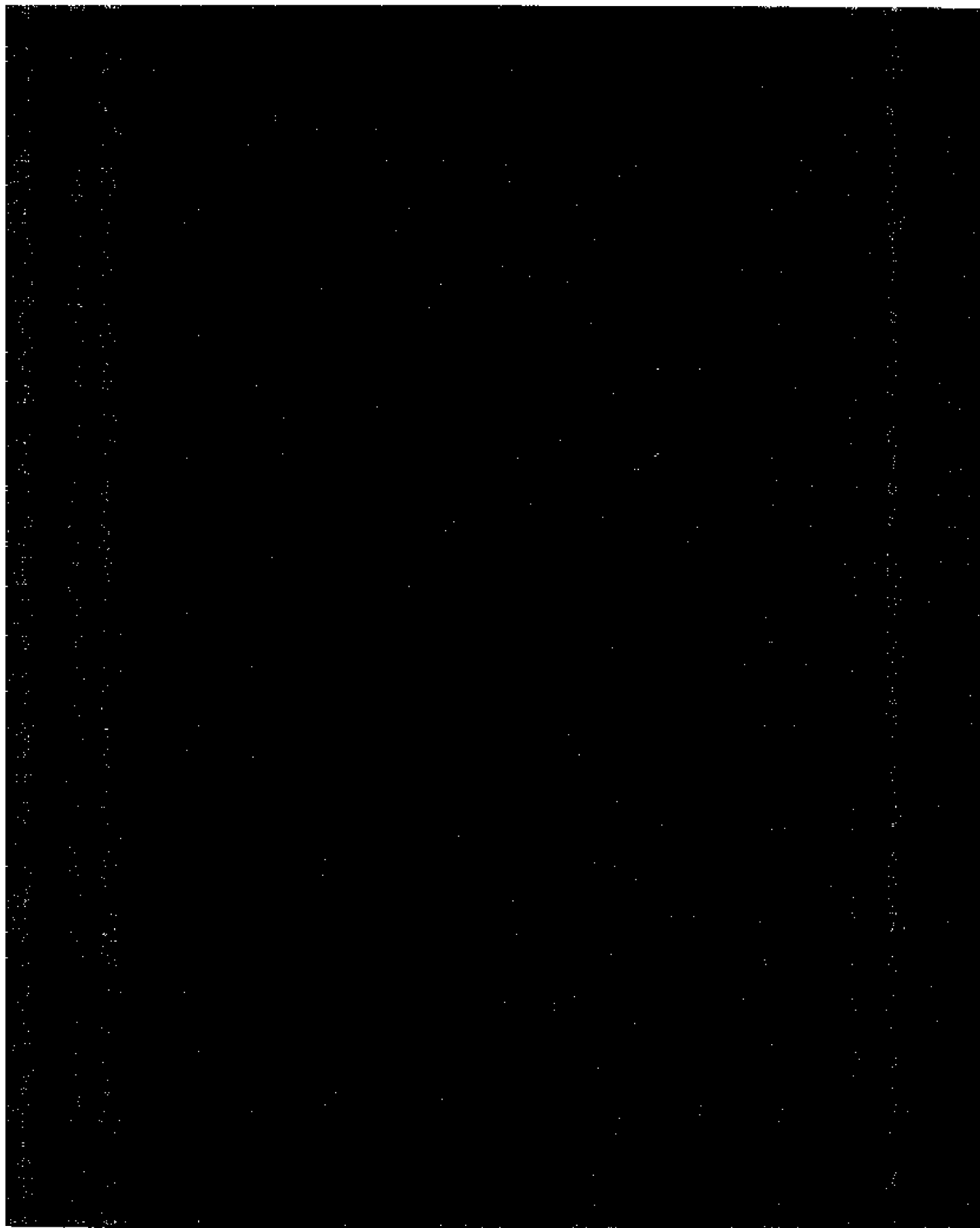


TABLE 1.
DATA SUMMARY FORM: INORGANICS
SHALLOW SOIL SAMPLES
(mg/Kg)

Sample Number Sample Location Analyte	GG TP-4S 0-6"	RBC* INDUSTRIAL mg/Kg 10/1/98	RBC* RESIDENTIAL mg/Kg 10/1/98	HSCA** (Shallow Soils) mg/Kg 2/1/98
Aluminum	8,840	2,044,000	N	20,000
Antimony		818	N	3
Arsenic	8.5	^610/3.8	N/C	20.4 N/C
Barium	334	143,080	N	550
Beryllium		4,100	N	0.5
Cadmium		2,044	N	4
Calcium	8,100	NL	NL	NL
Chromium	29.2	3,066,000/6,132	III/VI	1,000/270
Cobalt		122,640	N	470
Copper	121	81,760	N	1,000
Iron	17,100	613,200	N	23,000
Lead	1,510	**1,000	**400	400
Magnesium		NL	NL	NL
Manganese	210	40,880	N	180
Mercury	0.39	^610	N	10
Nickel	21.7	40,880	N	160
Potassium		NL	NL	NL
Selenium	2.1	10,220	N	39
Silver		10,220	N	39
Sodium		NL	NL	NL
Thallium		143	N	18
Vanadium	43.0	14,308	N	55
Zinc	341	613,200	N	1,000
Cyanide		40,880	N	160

^ - EPA Region III Risk-Based Concentration Tables J, Hubbard, 10/22/97
* - EPA Region III Risk-Based Concentration Tables J, Hubbard, 10-01-98
** - HSCA Uniform Risk Based Remediation Standards for nonresidential unrestricted land use, 2/1/98
(III & VI) - Chromium III, Chromium VI values
J - analyte Present. Reported value may not be accurate or precise.
NL - Not Listed
C - Carcinogenic
N - Non Carcinogenic
ND - Not Detected

TABLE 2.
DATA SUMMARY FORM: INORGANICS
DEEP SOIL SAMPLES
mg/Kg

Sample Number Sample Location Analyte	GG TP-2D 10'	GG TP-4C 3'	GG TP-9D 11'	GG TP-15 3' Duplicate of TP-4C	GG TP-16D 11' Duplicate of TP-9D	RBC* INDUSTRIAL mg/Kg 10/1/98	RBC* RESIDENTIAL mg/Kg 10/1/98	HSCA** (Deep Soils) mg/Kg 2/1/98
Aluminum	8,750	8,630	12,700	7,780	11,900	2,044,000	78,214	20,000
Antimony						818	31	3
Arsenic		10.2	18.0	12.3	40.8	610/3.8	23/0.43	2/0.4
Barium	76.1	413	216	529	194	143,080	5,475	550
Beryllium						4,100	160	0.5
Cadmium						2,044	78	4
Calcium	3,080	5,250	3,610	4,850	4,680	NL	NL	NL
Chromium	15.8	21.1	31.3	21.6	56.1	3,066,000/6,132	117,321/235	1,000/270
Cobalt	16.0				36.0	122,640	4,693	470
Copper		128	94.9	124	343	81,760	3,129	1,000
Iron	36,400	12,300	44,500	20,700	80,800	613,200	23,464	23,000
Lead	2.1	709	546	1,450	632	11,000	400	400
Magnesium	1,670					NL	NL	NL
Manganese	439	191	607	228	735	40,880	1,564	180
Mercury		0.46	0.79	0.62	0.46	610	23	10
Nickel	26.2	21.0	35.8	26.2	104	40,880	1,564	160
Potassium		1,640				NL	NL	NL
Selenium		3.2	2.9	4.1	4.2	10,220	391	39
Silver						10,220	391	39
Sodium						NL	NL	NL
Thallium						143	5.5	18
Vanadium	36.2	34.4	41.5	39.3	41.3	14,308	548	55
Zinc	18.7	863	889	1,010	1,510	613,200	23,464	1,000
Cyanide				0.76		40,880	1,564	160

* - EPA Region III Risk-Based Concentration Tables, I. Hubbard, 10/22/97

** - EPA Region III Risk-Based Concentration Tables, I. Hubbard, 10/1/98

*** - RSCA Uniform Risk Based Remediation Standards for nonhazardous land use, 2/1/98

(III & VI) - Chromium III, Chromium VI values

J = analyte present. Reported value may not be accurate or precise.

NL = Not Listed

C = Carcinogenic

N = Non Carcinogenic

ND = Not Detected

TABLE 3.
DATA SUMMARY FORM: VOLATILES (1)
DEEP SOIL SAMPLE
ug/Kg

Sample Number Sample Location	GC TP-2D 10'	RBC* Industrial Soil ug/Kg 10/1/98	RBC** Residential Soil ug/Kg 10/1/98
Chloromethane		440,000 C	49,000 C
Bromomethane		2,900,000 N	110,000 N
Vinyl Chloride		3,000 C	340 C
Chloroethane		820,000,000 N	31,000,000 N
Methylene Chloride		760,000 C	85,000 C
Acetone		200,000,000 N	7,800,000 N
Carbon Disulfide		200,000,000 N	7,800,000 N
1,1-Dichloroethene		9,500 C	1,100 C
1,1-Dichloroethane		200,000,000 N	7,800,000 N
1,2-Dichloroethene (total)		18,000,000 N	700,000 N
Chloroform		940,000 C	100,000 C
1,2-Dichloroethane		63,000 C	7,000 C
2-Butanone		NL	NL
1,1,1-Trichloroethane		220,000 C	25,000 C
Carbon Tetrachloride		44,000 C	4,900 C
Vinyl Acetate		1,000,000,000 N	78,000,000 N
Bromodichloromethane		92,000 C	10,000 C

* = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/01/98

NL = Not Listed

• = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/01/98

C = Carcinogenic

N = Non Carcinogenic

TABLE 4.
DATA SUMMARY FORM: VOLATILE (2)
DEEP SOIL SAMPLE
ug/Kg

Sample Number Sample Location	GG TP-2D 10'	RBC* Industrial Soil mg/Kg 10/1/98	RBC* Residential Soil mg/Kg 10/1/98
1,2-Dichloropropane		84,000 C	9,400 C
cis-1,3-Dichloropropene		33,000 C	3,700 C
Trichloroethene		520,000 C	58,000 C
Dibromochloromethane		NL	NL
1,1,2-Trichloroethane		100,000 C	11,000 C
Benzene		200,000 C	22,000 C
trans-1,3-Dichloropropene		33,000 C	3,700 C
Bromoform		720,000 C	81,000 C
4-Methyl-2-Pentanone		NL	NL
2-Hexanone		NL	NL
Tetrachloroethene		110,000 C	12,000 C
1,1,2,2-Tetrachloroethane		29,000 C	3,200 C
Toluene		410,000,000 N	16,000,000 N
Chlorobenzene		41,000,000 N	1,600,000 N
Ethylbenzene		200,000,000 N	7,800,000 N
Styrene		410,000,000 N	16,000,000 N
Xylene (total)		1,000,000,000 N	160,000,000 N

* = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/01/98

** = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/01/98+A58

NL = Not Listed

C = Carcinogenic

N = Non Carcinogenic

TABLE 5.
DATA SUMMARY FORM: SEMIVOLATILE (1)
SHALLOW SOIL SAMPLES

ug/Kg

Sample Number Sample Location	GG TP-3S 12-18"	GG TP-5S 12"	GG TP-6S 12-18"	GG TP-9S 12-18"	GG SS-4 0-6"	RBC * Industrial Soil ug/Kg 10/1/98	RBC * Residential Soil ug/Kg 10/1/98	HSCA URS** (Deep Soils) ug/Kg 2/1/98
Phenol						1,226,400,000	N	N
bis(2-Chloroethyl)ether						5,203	C	581
2-Chlorophenol						10,220,000	N	N
1,3-Dichlorobenzene (M)						61,320,000	N	N
1,4-Dichlorobenzene (P)						238,467	C	26,614
1,2-Dichlorobenzene (O)						183,960,000	N	7,039,286
2-Methylphenol						102,200,000	N	3,910,714
2,2'-oxybis(1-Chloropropane)						NL	NL	NL
4-Methylphenol						10,220,000	N	391,071
N-Nitroso-di-n-propylamine	UJ					818	C	91
Hexachloroethane						408,800	C	45,623
Nitrobenzene						1,022,000	N	39,107
Isophorone						6,024,421	C	672,343
2-Nitrophenol						NL	NL	NL
2,4-Dimethylphenol						40,880,000	N	1,564,286
bis(2-Chloroethoxy)methane						NL	NL	NL
2,4-Dichlorophenol						6,132,000	N	234,643
1,2,4-Trichlorobenzene						20,440,000	N	782,143
Naphthalene	130 J		170 J	120 J	920	40,880,000	N	1,564,286
4-Chloroaniline						8,176,000	N	312,857

* = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/01/98

** = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/01/98

** = HSCA Uniform Risk Based Remediation Standards for noncritical unrestricted land use, 2/1/98

J = analyte Present. Reported value may not be accurate or precise.

NL = Not Listed

C = Carcinogenic

N = Non Carcinogenic

TABLE 6.
DATA SUMMARY FORM: SEMIVOLATILE (2)
SHALLOW SOIL SAMPLES

ug/Kg

Sample Number Sample Location	GG TP-3S 12-18"	GG TP-5S 12"	GG TP-6S 12-18"	GG TP-9S 12-18"	GG SS-4 0-6"	RBC * Industrial Soils ug/Kg 10/1/98	RBC * Residential Soils ug/Kg 10/1/98	HSCA URS** (Deep Soils) ug/Kg 2/1/98
Hexachlorobutadiene						73,374	C	8,000
4-Chloro-3-methylphenol						NL	NL	NL
2-Methylnaphthalene	83 J		110 J	75 J	700	40,880,000	N	
Hexachlorocyclopentadiene		UJ	UJ	UJ		14,308,000	N	10,000
2,4,6-Trichlorophenol						520,091	C	58,000
2,4,5-Trichlorophenol						204,400,000	N	780,000
2-Chloronaphthalene (beta)						163,520,000	N	630,000
2-Nitroaniline						120,000^	N	500
Dimethyl phthalate						20,440,000,000	N	1,000,000
Acenaphthylene	170 J	51 J	160 J	210 J		NL	NL	NL
2,6-Dinitrotoluene						2,044,000	N	8,000
3-Nitroaniline						6,100,000^	N	23,000
Acenaphthene	840		240 J	150 J	1500	122,640,000	N	470,000
2,4-Dinitrophenol						40,880,000	N	16,000
4-Nitrophenol						16,352,000	N	63,000
Dibenzofuran	710		190 J	160 J	970	8,176,000	N	31,000
2,4-Dinitrotoluene						4,088,000	N	16,000
Diethyl phthalate						1,635,200,000	N	1,000,000
4-Chlorophenyl-phenyl ether						NL	NL	NL
Fluorene	1,200	20 J	250 J	200 J	1,300	81,760,000	N	310,000
4-Nitroaniline	UJ					6,100,000^	N	23,000
4,6-Dinitro-2-methylphenol						204,400	N	NL

* = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/22/97

** = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/01/98

*** = HSCA Uniform Risk-Based Remediation Standards for commercial unrestricted land use, 2/1/98

J = Analyte Present. Reported value may not be accurate or precise

NL = Not Listed

C = Carcinogenic

N = Non Carcinogenic

TABLE 7.
DATA SUMMARY FORM: SEMIVOLATILE (3)
SHALLOW SOIL SAMPLES

ug/Kg

Sample Number Sample Location	GG TP-3S 12-18"	GG TP-5S 12"	GG TP-6S 12-18"	GG TP-9S 12-18"	GG SS-4 0-6"	RBC * Industrial Soil ug/Kg 10/1/98	RBC * Residential Soil ug/Kg 10/1/98	HSCA ** URS ug/Kg 2/1/98
N-Nitrosodiphenylamine (I)						1,168,000 C	130,352 C	130,000
4-Bromophenyl-phenyl ether						120,000,000^	4,500,000^	450,000
Hexachlorobenzene						3,577 C	399 C	400
Pentachlorophenol						47,693 C	5,323 C	5,000
Phenanthrene	10,000	290 J	2,000	1,700	8,200	NL	NL	1,000,000
Anthracene	3,700	61 J	440	340 J	2,400	613,200,000 N	23,464,286 N	1,000,000
Carbazole	1,400	39 J	320 J	240 J	1,800	286,160 C	31,936 C	32,000
Di-n-butylphthalate						NL	NL	NL
Fluoranthene	23,000	740	2,500	1,900	9,100	81,760,000 N	3,128,571 N	310,000
Pyrene	21,000	950	2,900	2,400	8,700	61,320,000 N	2,346,429 N	230,000
Butyl benzyl phthalate	57 J					408,800,000 N	15,642,857 N	930,000
3,3'-Dichlorobenzidine						12,718 C	1,419 C	1,000
Benzo(a)anthracene	14,000	550	1,700	1,200	5,500	7,840 C	875 C	900
Chrysene	14,000	650	1,900	1,400	6,100	784,000 C	87,497 C	88,000
bis(2-Ethylhexyl)phthalate (DEHP)						408,800 C	45,623 C	46,000
di-n-Octyl phthalate						40,880,000 N	1,564,286 N	160,000
Benzo(b)fluoranthene	14,000	560	2,000	1,400	5,400	7,840 C	875 C	900
Benzo(k)fluoranthene	8,000 J	390	460	480	3,500	78,400 C	8,750 C	9,000
Benzo(a)pyrene	11,000	550	1,400	1,100	4,900	784 C	87 C	90
Indeno(1,2,3-cd)Pyrene	8,900	440 J	940 J	770 J	3,100 J	7,840 C	875 C	900
Dibenzo(a,h)anthracene	3,400	160 J	430	310 J	1,500	784 C	87 C	90
Benzo(g,h,i)perylene	7,300	330 J	660 J	520 J	2,000 J	NL	NL	NL

^ = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/22/97

* = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/22/98

** = HSCA Uniform Risk-based Remediation Standards for noncritical unrestricted land use, 2/1/98

J = Analyte Present. Reported value may not be accurate or precise

NL = Not Listed

C = Carcinogenic

N = Non Carcinogenic

TABLE 8.
DATA SUMMARY FORM: SEMIVOLATILE (1)
DEEP SOIL SAMPLES
ug/Kg

Sample Number Sample Location	GG TP-2D 10'	GG TP-10D 11'	RBC * Industrial Soil ug/Kg 10/1/98	RBC * Residential Soil ug/Kg 10/1/98	HSCA URS** (Deep Soils) ug/Kg 2/1/98
Phenol			1,226,400,000 N	46,928,571 N	1,000
bis(2-Chloroethyl)ether			5,203 C	581 C	200
2-Chlorophenol			10,220,000 N	391,071 N	39,000
1,3-Dichlorobenzene (M)			61,320,000 N	2,346,429 N	700,000
1,4-Dichlorobenzene (P)			238,467 C	26,614 C	27,000
1,2-Dichlorobenzene (O)			183,960,000 N	7,039,286 N	560,000
2-Methylphenol			102,200,000 N	3,910,714 N	390,000
2,2'-oxybis(1-Chloropropane)			NL	NL	NL
4-Methylphenol			10,220,000 N	391,071 N	39,000
N-Nitroso-di-n-propylamine			818 C	91 C	90
Hexachloroethane			408,800 C	45,623 C	46,000
Nitrobenzene			1,022,000 N	39,107 N	4,000
Isophorone			6,024,421 C	672,343 C	670,000
2-Nitrophenol			NL	NL	NL
2,4-Dimethylphenol			40,880,000 N	1,564,286 N	160,000
bis(2-Chloroethoxy)methane			NL	NL	NL
2,4-Dichlorophenol			6,132,000 N	234,643 N	23,000
1,2,4-Trichlorobenzene			20,440,000 N	782,143 N	78,000
Naphthalene		140 J	40,880,000 N	1,564,286 N	310,000
4-Chloroaniline			8,176,000 N	312,857 N	31,000

* = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/01/98

** = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/01/98

*** = HSCA Uniform Risk Based Remediation Standards for noncritical unrestricted land use, 2/1/98

J = analyte Present. Reported value may not be accurate or precise.

NL = Not Listed
C = Carcinogenic
N = Non Carcinogenic

TABLE 9.
DATA SUMMARY FORM: SEMIVOLATILE (2)
DEEP SOIL SAMPLES
ug/Kg

Sample Number Sample Location	GG TP-2D 10'	GG TP-10D 11'	RBC * Industrial Soils ug/Kg 10/1/98	RBC * Residential Soils ug/Kg 10/1/98	HSCA URS** (Deep Soils) ug/Kg 2/1/98
Hexachlorobutadiene			73,374 C	8,189 C	8,000
4-Chloro-3-methylphenol			NL	NL	NL
2-Methylnaphthalene		95 J	40,880,000 N	1,564,286 N	
Hexachlorocyclopentadiene					
2,4,6-Trichlorophenol	UJ		14,308,000 N	547,500 N	10,000
2,4,5-Trichlorophenol			520,091 C	58,066 C	58,000
2-Chloronaphthalene (beta)			204,400,000 N	7,821,429 N	780,000
2-Nitroaniline			163,520,000 N	6,257,143 N	630,000
Dimethyl phthalate			120,000^ N	4,700^ N	500
Acenaphthylene			20,440,000,000 N	782,142,857 N	1,000,000
2,6-Dinitrotoluene		180 J	NL	NL	NL
3-Nitroaniline			2,044,000 N	78,214 N	8,000
Acenaphthene			6,100,000^ N	230,000^ N	23,000
2,4-Dinitrophenol		300 J	122,640,000 N	4,692,857 N	470,000
4-Nitrophenol			40,880,000 N	1,564,286 N	16,000
Dibenzofuran			16,352,000 N	625,714 N	63,000
2,4-Dinitrotoluene		260 J	8,176,000 N	312,857 N	31,000
Diethyl phthalate			4,088,000 N	156,429 N	16,000
4-Chlorophenyl-phenyl ether			1,635,200,000 N	62,571,429 N	1,000,000
Fluorene			NL	NL	NL
		430	81,760,000 N	3,128,571 N	310,000
4-Nitroaniline			6,100,000^ N	230,000^ N	23,000
4,6-Dinitro-2-methylphenol			204,400 N	78,210 N	NL

^ = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/01/98

* = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/01/98

** = HSCA Uniform Risk-based Remediation Standards for unrestricted land use, 2/1/98

J = Analyte Present. Reported value may not be accurate or precise

NL = Not Listed

C = Carcinogenic

N = Non Carcinogenic

ND = Not Detected

TABLE 10.
DATA SUMMARY FORM: SEMIVOLATILE (3)
DEEP SOIL SAMPLES
ug/Kg

Sample Number Sample Location	GC TP-2D 10'	GG TP-10D 11'	RBC * Industrial Soil ug/Kg 10/1/98	RBC * Residential Soil ug/Kg 10/1/98	HSCA ** URS ug/Kg 2/1/98
N-Nitrosodiphenylamine (I)			1,168,000 C	130,352 C	130,000
4-Bromophenyl-phenyl ether			120,000,000^	4,500,000^	450,000
Hexachlorobenzene			3,577 C	399 C	400
Pentachlorophenol			47,693 C	5,323 C	5,000
Phenanthrene		2,600	NL	NL	1,000,000
Anthracene		740	613,200,000 N	23,464,286 N	1,000,000
Carbazole		410	286,160 C	31,936 C	32,000
Di-n-butylphthalate			NL	NL	NL
Fluoranthene		2,800	81,760,000 N	3,128,571 N	310,000
Pyrene		3,400	61,320,000 N	2,346,429 N	230,000
Butyl benzyl phthalate			408,800,000 N	15,642,857 N	930,000
3,3'-Dichlorobenzidine			12,718 C	1,419 C	1,000
Benzo(a)anthracene		2,000	784,000 C	875 C	900
Chrysene		2,000	784,000 C	87,497 C	88,000
bis(2-Ethylhexyl)phthalate (DEHP)			408,800 C	45,623 C	46,000
di-n-Octyl phthalate			40,880,000 N	1,564,286 N	160,000
Benzo(b)fluoranthene		1,800	7,840 C	875 C	900
Benzo(k)fluoranthene		640	78,400 C	8,750 C	9,000
Benzo(a)pyrene		1,400	784 C	87 C	90
Indeno(1,2,3-cd)Pyrene	UJ	1200 J	7,840 C	875 C	900
Dibenz(a,h)anthracene		450	784 C	87 C	90
Benzo(g,h,i)perylene	UJ	1000 J	NL	NL	NL

^ = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/01/98

* = EPA Region III Risk-Based Concentration Tables, J. Hubbard, 10/01/98

** = HSCA Uniform Risk-based Remediation Standards for noncritical unrestricted land use, 2/1/98

J = Analyte Present. Reported value may not be accurate or precise

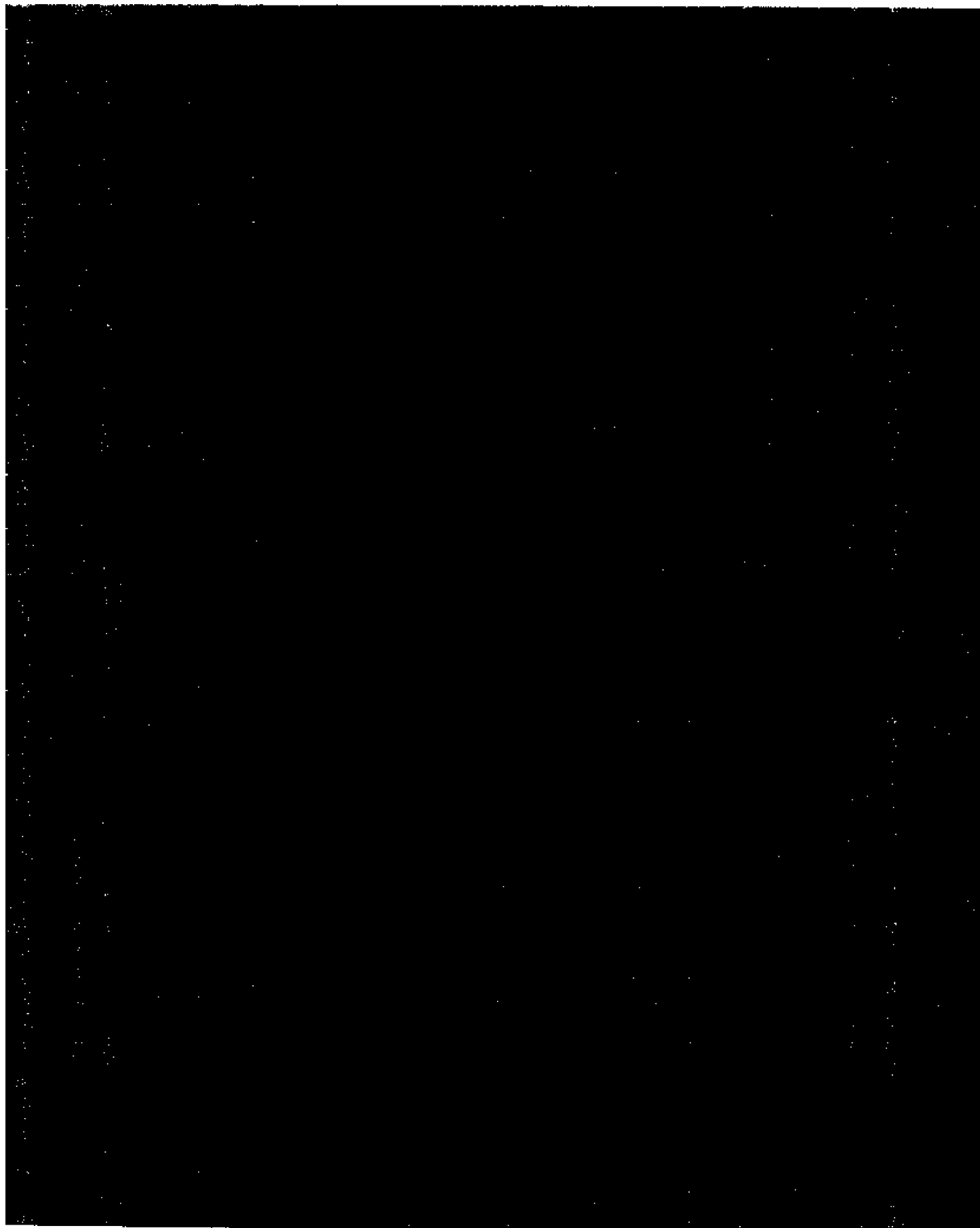
NL = Not Listed

C = Carcinogenic

N = Non Carcinogenic

TABLE 11.
DATA SUMMARY FORM: PESTICIDES AND PCB'S
SOIL SAMPLES
ug/Kg

Sample Number Sample Location	GG TP-2D 10'
alpha-BHC	
beta-BHC	
delta-BHC	
gamma-BHC (Lindane)	
Heptachlor	
Aldrin	
Heptachlor epoxide	
Endosulfan I	
Dieldrin	
4,4-DDE	
Endrin	
Endosulfan II	
4,4-DDD	
Endosulfan sulfate	
4,4-DDT	
Methoxychlor	
Endrin ketone	
Endrin aldehyde	
alpha-Chlordane	
gamma-Chlordane	
Toxaphene	
Aroclor-1016	
Aroclor-1221	
Aroclor-1252	
Aroclor-1242	
Aroclor-1248	
Aroclor-1254	
Aroclor-1260	



Site: George Gray School

DATA SUMMARY FORM: INORGANICS X-RAY FLUORESCENCE (XRF)

Sampling Date: December 1-2, 1998

Shallow Soil Samples
mg/kg

Sample Number	TP-1s	TP-2s	TP-3s	TP-4s	TP-5s	TP-6s	TP-7s	TP-8s
Sample Location	12"	12"	12-18"	12-18"	12"	12-18"	12-18"	24"
Analyte								
Antimony	1.12	1.72	2.45	4.12	3.66	0.994	4.78	ND
Arsenic	3.55	ND	18.6	65.0	24.7	12.4	11.4	8.93
Barium	332.3	310.9	330.2	691.7	388.1	346.5	339.9	371.0
Cadmium	0.598	0.813	2.88	ND	0.582	1.37	ND	1.03
Calcium	13127	9361	4576	16627	5173	4165	4409	3455
Chromium	88.2	80.6	86.6	190.3	77.8	106.5	41.2	50.6
Cobalt	23.1	ND	56.4	66.6	106.5	5.52	113.4	65.5
Copper	34.8	31.2	55.9	257.6	92.1	71.3	46.5	20.6
Iron	45249	38656	35220	34147	32787	28219	30820	30066
Lead	18.2	52.8	185.1	1744	277.8	74.0	103.4	23.7
Manganese	497.1	829.6	529.9	627.2	687.9	326.9	516.4	426.3
Mercury	ND	2.09	ND	ND	ND	0.966	ND	ND
Nickel	29.1	41.4	46.5	149.4	2.79	70.1	1.47	36.1
Selenium	4.19	0.604	ND	ND	1.63	ND	ND	ND
Silver	ND	ND	ND	1.41	0.218	0.034	0.147	0.214
Thallium	ND	ND	ND	ND	ND	7.26	ND	ND
Vanadium	120.0	96.0	131.4	204.9	122.4	113.5	63.1	92.1
Zinc	59.1	74.1	178.5	813.8	229.5	74.7	97.5	43.0

Note: Elevated levels of iron in samples may result in increased cobalt readings.
Elevated levels of lead in samples may result in increased arsenic readings.

ND = Not Detected

Bold = Sample sent to laboratory for TAL (metals) analysis

fig8116.xls

Site: George Gray School

DATA SUMMARY FORM: INORGANICS X-RAY FLUORESCENCE (XRF)

Sampling Date: December 1-2, 1998

Shallow Soil Samples

mg/kg

Sample Number	TP-9s	TP-10s	TP-11s	SS-1	SS-2	SS-3	SS-4	SS-5
Sample Location	12-18"	12"	12"	0-12"	0-18"	0-5"	0-6"	0-5"
Analyte								
Antimony	ND	ND	0.106	ND	ND	ND	2.73	ND
Arsenic	17.3	33.2	3.25	10.1	8.31	10.9	12.0	5.47
Barium	305.2	446.3	480.8	325.0	438.8	403.0	375.3	366.2
Cadmium	0.720	0.203	1.40	ND	1.74	ND	ND	1.65
Calcium	10122	7972	4436	2983	4485	4871	5387	5975
Chromium	74.7	101.0	110.4	52.2	66.3	47.2	52.9	66.5
Cobalt	59.8	84.5	18.8	ND	95.4	32.3	105.0	120.4
Copper	58.0	50.4	31.2	38.6	33.0	34.2	43.9	54.9
Iron	35026	58822	39265	23277	39670	26444	30851	29716
Lead	246.9	312.7	52.8	76.2	70.2	117.7	100.7	136.5
Manganese	528.8	761.1	598.9	779.7	517.8	586.5	568.6	525.1
Mercury	6.13	4.70	ND	6.82	10.0	6.17	2.68	3.39
Nickel	10.0	ND	50.4	18.7	16.3	46.1	23.7	64.9
Selenium	ND	ND	4.05	0.261	4.24	0.603	ND	ND
Silver	ND	ND	0.528	0.754	1.24	1.37	0.130	2.35
Thallium	ND	ND	ND	ND	ND	1.89	1.24	ND
Vanadium	127.6	113.0	96.6	87.6	99.6	52.5	95.8	98.8
Zinc	213.2	155.7	99.8	71.9	107.6	134.8	128.3	142.2

Note: Elevated levels of iron in samples may result in increased cobalt readings.

Elevated levels of lead in samples may result in increased arsenic readings.

ND = Not Detected

Bold = Sample sent to laboratory for TAL (metals) analysis

ij98116.xls

Site: George Gray School

DATA SUMMARY FORM: INORGANICS

Sampling Date: December 1-2, 1998

X-RAY FLUORESCENCE (XRF)

Deep Test Pit Soil Samples

mg/kg

Sample Number	TP-1d	TP-2d	TP-3d	TP-4d	TP-4c	TP-5d	TP-6d	TP-7d
Sample Location	12-13'	10'	12'	12-13'	3'	11'	11-12'	10-11'
Analyte								
Antimony	0.592	2.65	3.20	ND	9.22	ND	0.508	ND
Arsenic	1.18	1.18	ND	1.90	100.3	1.13	8.99	8.26
Barium	258.0	400.5	91.6	108.4	780.5	188.7	467.2	361.8
Cadmium	ND	ND	ND	0.657	0.552	1.07	ND	ND
Calcium	9628	5398	5518	8278	8511	2525	7017	3646
Chromium	60.0	67.8	77.1	89.0	192.6	61.8	63.6	83.0
Cobalt	181.2	80.8	75.6	ND	18.2	74.8	68.3	53.4
Copper	39.7	16.4	ND	107.6	322.9	12.0	45.0	21.8
Iron	105059	75163	79277	119147	34121	29115	32409	41028
Lead	ND	13.5	10.3	5.07	2145	18.0	154.5	27.5
Manganese	2086	1500	719.7	601.6	484.0	726.6	463.9	503.3
Mercury	ND	2.72	ND	ND	3.03	5.22	ND	4.12
Nickel	63.8	30.1	50.7	57.1	95.3	30.9	45.8	ND
Selenium	ND	ND	ND	ND	ND	1.31	0.508	1.12
Silver	1.03	1.45	ND	0.426	0.015	ND	1.83	ND
Thallium	ND	2.11	4.53	6.42	0.324	2.62	ND	2.41
Vanadium	196.5	155.3	139.0	177.5	193.3	136.7	71.2	67.0
Zinc	141.6	66.0	49.5	128.6	1050	52.1	164.4	56.2

Note: Elevated levels of iron in samples may result in increased cobalt readings.

Elevated levels of lead in samples may result in increased arsenic readings.

ND = Not Detected

Bold = Sample sent to laboratory for TAL (metals) analysis

ijj88116.xls

Site: George Gray School

Sampling Date: December 1-2, 1998

**DATA SUMMARY FORM: INORGANICS
X-RAY FLUORESCENCE (XRF)
Deep Test Pit Soil Samples**

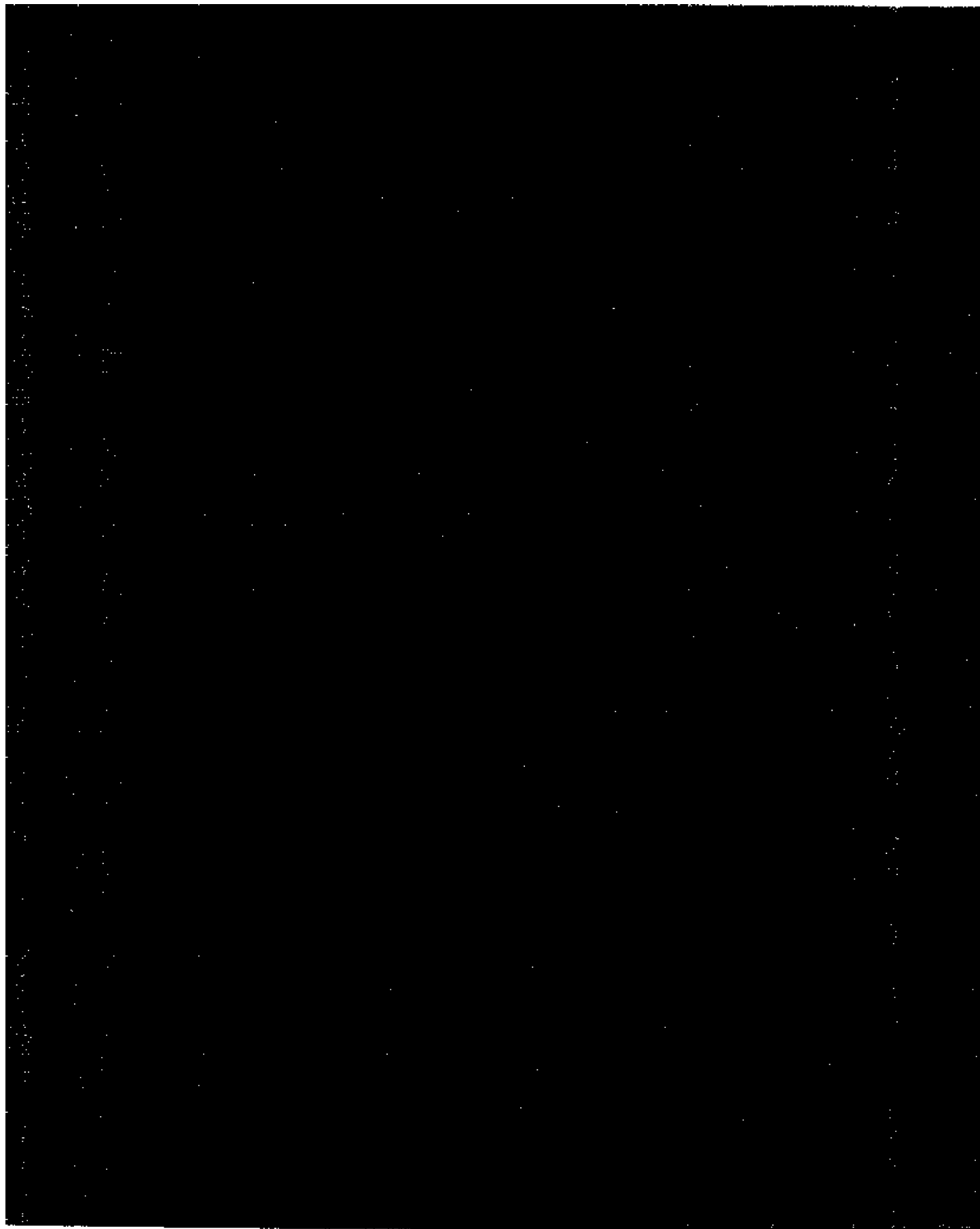
mg/kg

Sample Number	TP-8d	TP-9d	TP-10d	TP-11d	TP-15	TP-16
Sample Location	11-12'	11'	11'	10-11'	3'	11'
Analyte					Duplicate of TP-4c	Duplicate of TP-9d
Antimony	4.25	5.16	5.08	ND	7.78	5.13
Arsenic	7.27	33.1	27.9	8.38	37.0	41.7
Barium	274.7	683.6	242.5	328.1	876.3	717.3
Cadmium	ND	0.350	0.949	ND	0.455	3.25
Calcium	3105	6442	11307	3658	9640	6179
Chromium	76.6	168.2	83.6	48.7	164.8	181.0
Cobalt	88.9	208.9	19.5	26.3	40.0	17.8
Copper	26.2	226.1	63.6	29.5	321.0	219.7
Iron	38880	64893	33090	21887	32385	63187
Lead	25.2	920.2	262.3	32.9	1121	768.8
Manganese	349.1	821.1	444.1	801.2	544.8	752.3
Mercury	3.60	ND	0.420	ND	ND	ND
Nickel	ND	101.6	38.7	6.06	120.2	73.8
Selenium	ND	ND	1.10	1.95	3.33	ND
Silver	1.50	1.68	0.656	2.35	0.161	ND
Thallium	2.32	ND	4.95	ND	ND	ND
Vanadium	183.1	161.3	97.9	55.2	216.5	208.3
Zinc	47.4	1394	197.2	62.8	1148	1315

Note: Elevated levels of iron in samples may result in increased cobalt readings.
Elevated levels of lead in samples may result in increased arsenic readings.

ND = Not Detected

Bold = Sample sent to laboratory for TAL (metals) analysis

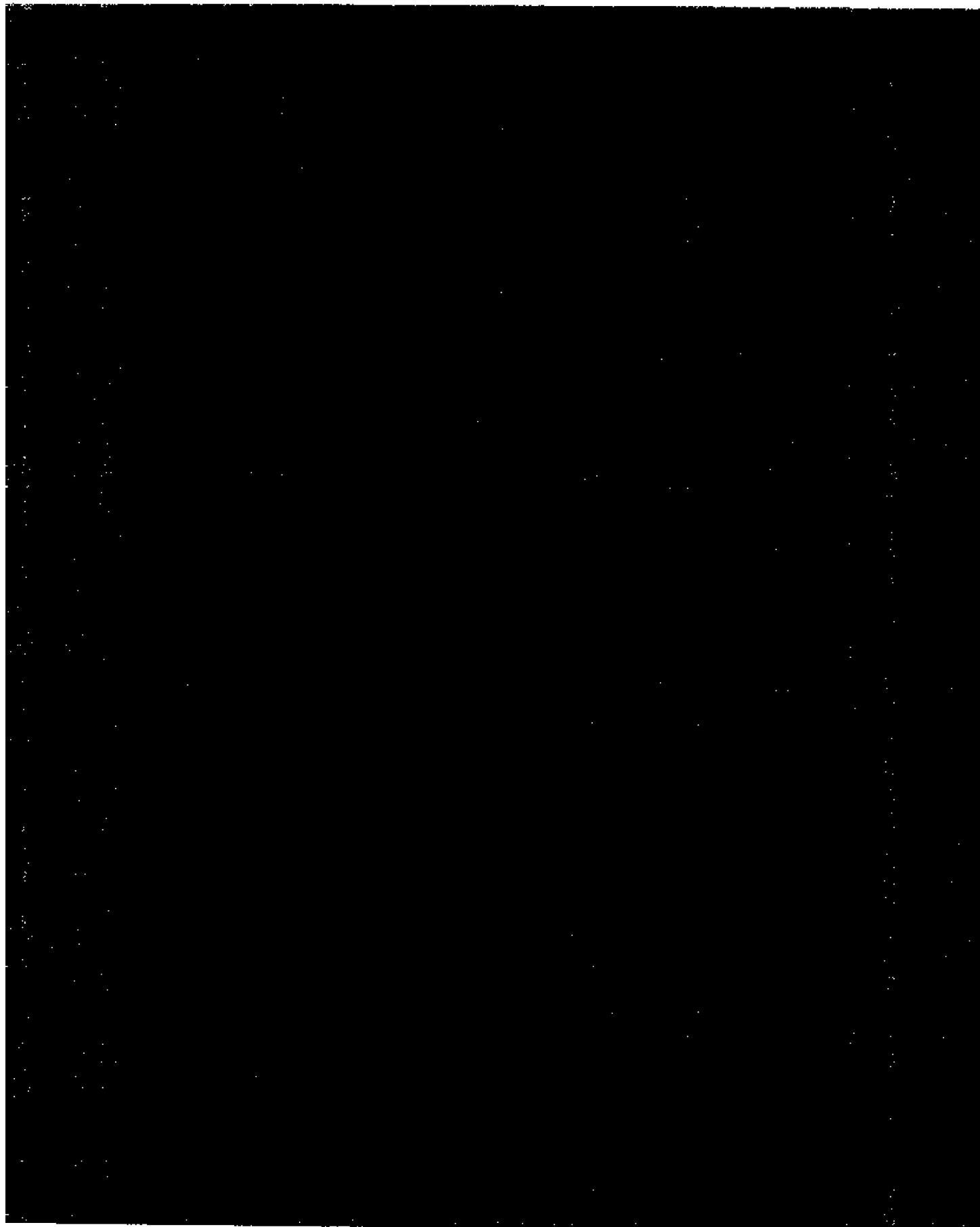


SCREENING DATA - DATA IS NOT VALIDATED
GEORGE GRAY SCHOOL
POLYCHLORINATED BIPHENYLS (PCB) IMMUNOASSAY TEST RESULTS
COMPARISON WITH LABORATORY DATA

SAMPLE ID	IMMUNOASSAY RESULT mg/Kg	LABORATORY RESULT mg/Kg	CONFIRMATION YES / NO
SHALLOW TEST PIT SAMPLES			
TP-1S	ND	N/A	N/A
TP-2S	ND	N/A	N/A
TP-3S	ND	N/A	N/A
TP-4S	ND	N/A	N/A
TP-5S	ND	N/A	N/A
TP-6S	ND	N/A	N/A
TP-7S	ND	N/A	N/A
TP-8S	ND	N/A	N/A
TP-9S	ND	N/A	N/A
TP-10S	ND	N/A	N/A
TP-11S	ND	N/A	N/A
SHALLOW SOIL SAMPLES			
SS-1	ND	N/A	N/A
SS-2	ND	N/A	N/A
SS-3	ND	N/A	N/A
SS-4	ND	N/A	N/A
SS-5	ND	N/A	N/A
DEEP TEST PIT SAMPLES			
TP-1D	ND	N/A	N/A
TP-2D	ND	ND	YES
TP-3D	ND	N/A	N/A
TP-4D	ND	N/A	N/A
TP-4C	ND	N/A	N/A
TP-5D	ND	N/A	N/A
TP-6D	ND	N/A	N/A
TP-7D	ND	N/A	N/A
TP-8D	ND	N/A	N/A
TP-9D	ND	N/A	N/A
TP-10D	ND	N/A	N/A
TP-11D	ND	N/A	N/A
ND - Non-detected NT - Not tested - No field screening data N/A - Not applicable - No laboratory data Bold - Sample submitted for laboratory PCB analysis			

SCREENING DATA - DATA IS NOT VALIDATED
GEORGE GRAY SCHOOL
POLYAROMATIC HYDROCARBON (PAH) IMMUNOASSAY TEST RESULTS
COMPARISON WITH LABORATORY DATA

SAMPLE ID	IMMUNOASSAY RESULT mg/Kg	LABORATORY RESULT mg/Kg*	CONFIRMATION YES / NO
SHALLOW TEST PIT SAMPLES			
TP-1S	>1, <50	N/A	N/A
TP-2S	>1, <50	N/A	N/A
TP-3S	>50	>140	YES
TP-4S	>1, <50	N/A	N/A
TP-5S	>50	8.2 + TNR	YES
TP-6S	>50	24.9 + TNR	YES
TP-7S	>1, <50	N/A	N/A
TP-8S	>1, <50	N/A	N/A
TP9S	>50	21.7 + TNR	YES
TP-10S	>1, <50	N/A	N/A
TP-11S	>1, <50	N/A	N/A
SHALLOW SOIL SAMPLES			
SS-1	>1, <50	N/A	N/A
SS-2	>1, <50	N/A	N/A
SS-3	>1, <50	N/A	N/A
SS-4	>50	>75	YES
SS-5	>1, <50	N/A	N/A
DEEP TEST PIT SAMPLES			
TP-1D	<1	N/A	N/A
TP-2D	<1	0	YES
TP-3D	<1	N/A	N/A
TP-4D	<1	N/A	N/A
TP-4C	>1, <50	N/A	N/A
TP-5D	<1	N/A	N/A
TP-6D	>1, <50	N/A	N/A
TP-7D	>1, <50	N/A	N/A
TP-8D	>1, <50	N/A	N/A
TP9D	>1, <50	N/A	N/A
TP-10D	>50	28.9 + TNR	YES
TP-11D	<1	N/A	N/A
NT - Not tested - No field screening data N/A - Not Applicable - No Laboratory Data *TCL Polyaromatic Hydrocarbons + TICs TICs - Tentatively Identified Compounds TNR - TICs not reported Bold - Samples sent to laboratory for PAH analysis			



TOXICOLOGICAL EVALUATION
FOR
THE FORMER GEORGE GRAY ELEMENTARY SCHOOL
WILMINGTON, DELAWARE

June, 1999

(Brownfields Preliminary Assessment II)

**DELAWARE DEPARTMENT OF NATURAL RESOURCES AND
ENVIRONMENTAL CONTROL**

DIVISION OF AIR AND WASTE MANAGEMENT

SITE INVESTIGATION & RESTORATION BRANCH

391 LUKENS DRIVE

NEW CASTLE, DELAWARE 19720

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1.0 Summary

A Brownfields Preliminary Assessment II was performed at the former George Gray Elementary School site to collect necessary data to evaluate the potential threat to human health and the environment resulting from historical site-related activities. Sampling was undertaken to characterize the on-site soils on the property.

Potential increased cancer risks were found for future on-site workers and for theoretical future adult and child residents via the inadvertent ingestion of contaminated surface or deep soils from the site when modeled under a worst case scenario. Currently there is no potable groundwater usage in the assessment area and due to a lack of groundwater resources this pathway was not evaluated.

For the theoretical future resident child and trespassing child receptors, potential non-cancer effects resulting from inadvertent ingestion of soil could not be ruled out when modeled using the soil exposure scenario for shallow and deep soil. As noted above, no groundwater use scenario was evaluated.

Increased incremental lifetime cancer risk was evaluated for seven compounds in soil; Benzo(a)pyrene (BaP), Arsenic (as a carcinogen), Dibenzo(a,h)anthracene (DahA), Benzo(a)anthracene (BaA), Benzo(b)fluoranthene (BbF), Indeno(1,2,3-cd)pyrene (IP) and Benzo(k)fluoranthene (BkF).

BaP and DahA found in sample TP-3S at 11.0 and 3.4 mg/Kg, respectively, and Arsenic detected at a concentration of 40.8 mg/Kg in sample TP-16D (field duplicate of TP-9D) provided for cancer risks of $1.20\text{E-}04$, $3.9\text{E-}05$ and $9.6\text{E-}05$ respectively, when modeled for a future adult resident of the site. As modeled for the on-site worker the increased cancer risks for BaP, DahA and Arsenic were $2.8\text{E-}05$, $8.6\text{E-}06$ and $2.1\text{E-}06$, respectively. BaA, BbF, and IP all had modeled increased incremental lifetime cancer risks greater than $1.0\text{E-}06$ when evaluated individually for the future adult resident. Risk for the theoretical future resident when evaluated cumulatively ($3.0\text{E-}04$) exceeded the $1.0\text{E-}04$ to $1.0\text{E-}06$ acceptable cancer risk range normal used by U.S. EPA, Region III, while the cumulative modeled risk for the on-site worker ($6.7\text{E-}05$) fell within the target range. It should be noted that the highest concentrations of BaP, DahA and other polycyclic aromatic hydrocarbons (PAHs) were detected in sample TP-3S, collected from beneath the asphalt parking lot, where casual exposure would be minimal.

The potential for future adverse health effects through the inadvertent ingestion of soil for future adult and child residents, workers and trespassing adults and children as modeled indicate that the non-cancer effects of Iron and Arsenic in deep soil sample TP-16D were the primary contributors to the hazard index (HI). Two modeled receptors (future resident child and trespassing child) had an HI in excess of the target of 1.0 (6.16 and 1.37). All other HIs were below the target of 1.0.

Two (2) out of the six (6) shallow and deep soil samples analyzed for Lead during the study contained Lead at levels exceeding the Delaware Uniform Risk-Based Remediation Standard of 1000 mg/Kg for restricted use soils and three (3) others exceeded the unrestricted use level of 400 mg/Kg. No reference dose exists for Lead. The highest concentration of Lead in soil detected during this study was 1510 mg/Kg in shallow test pit soil sample TP-4S.

Due to the lack of a direct surface water pathway, no surface water or sediment exposure scenarios were evaluated.

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2.0 Support Documentation for Toxicological Evaluation

Standard and default toxicological values and assumptions were applied herein and most can be found in the Appendices. The corrected (April 12, 1999) Risk-Based Concentration Table from U.S. EPA, Region III, was used as a screening tool to identify chemicals of concern. Modeled parameters and procedures were based on the Risk Assessment Guidance for Superfund (RAGs) and can be found in the References and/or Appendices as noted above. Lifetime cancer risks were developed for adult resident life exposure and are slightly less conservative than a combined child and adult exposure time of 30 years with adjusted body weight. The reported findings result in an insignificant modeled difference yet the recognition of this application to the model should be sufficient to address any concerns.

Reference dose and cancer slope factors were obtained from the Risk-Based Concentration (April 12, 1999) tables from U.S. EPA, Region III. IRIS was used as a source of toxicological information and the U.S. EPA listing of AWQC for chronic exposure to aquatic organisms was surveyed for exceedances.

Sample analysis data used in this evaluation were compiled from the Organic and Inorganic Data Validation Reports as qualified and received from the DNREC-SIRB Analytical Chemist.

2.1 Exposure Pathways

For the purposes of this evaluation the study area was treated as one site for evaluating the soil exposure pathway as a worst-case scenario. In general, the highest concentrations of organic and inorganic contaminants detected during this study were used in the models regardless of the sample location. The evaluation included the evaluation of deep soil samples to account for the potential excavation of soils during construction and renovation.

The George Gray School property consists of a single parcel totaling approximately 4 acres and comprising the majority of a city block. The site is located north and east of the City of Wilmington business district.

The site is bounded by Vandever Avenue, Locust Street, 23rd Street and Thatcher Street. A row of homes is located along the Vandever Avenue side of the property. A large "L"-shaped multi-story brick building (a former elementary school) is located near the center of the property. A large asphalt paved parking lot, surrounded by a locked gate and fence, is located on the southwest side of the building. The parking lot is cracked and broken with weeds and grass growing through the cracks. A large grassed field is located on the northeast side of the building property. A small open paved area, the former playground, is at the north end of the building.

The building is currently undergoing asbestos and lead paint abatement on the inside of the structure. An office trailer is located in the south parking lot and a storage trailer is on the northwest side of the building.

Parks and open space are located on adjacent parcels on both the north and south sides of the school property. Private homes and apartments, and a small church border the remainder of the site.

There is no surface water on or directly bordering the site. The Brandywine Creek is located approximately 900 feet west of the subject property. Surface water coming from the site is expected to flow into the Brandywine Creek through overland flow, or into a combined sanitary and storm sewer system operated by the City of Wilmington. During major storm events, excess water may discharge to the river from Combined Sewer Overflows (CSO) located along the Brandywine Creek, just north of Northeast Blvd.

The George Gray School property is located within the Piedmont Physiographic Province lying just north of the Fall Line (or Fall Zone) which runs almost along the course of the Christina River.

The basement rock beneath the site is part of the metamorphic and igneous derived Wilmington Complex. Meta-igneous rocks formed mainly of andesine, hypersthene, clinopyroxene and magnetite with minor amphibole underlie the majority of the site. The southwest corner may be composed mainly of hypersthene-quartz-andesine-gneiss with minor biotite and magnetite. The thickness of the regolith at the site may vary from 0 to 50 feet.

The water table aquifer in the Piedmont generally forms at the base of the regolith, directly above the unweathered bedrock. The depth to groundwater varies depending on the depth of the weathering and may be locally shallow. The Wilmington Complex stores and transmits groundwater almost entirely within fractures and generally in small quantities. Groundwater yields from the hard rock of the Wilmington Complex are generally low, with the yield of the average home well approximately 1 gallon per minute.

From the Fall Line south, the crystalline basement rock is overlain by the Potomac Formation, consisting of variegated clays and silts with some interbedded sands. These sands are generally thin and irregular in the northern part of the Coastal Plain. The Potomac Formation thickens to the southeast but is expected to be generally thin immediately south of the project area. The Potomac Formation is used extensively for water supply to the south of the project area where the sand layers are sufficiently thick.

The study area is expected to have little potential for significant groundwater supply development as a result of low yields due to low transmissivity of the aquifers and little available drawdown.

The George Gray School property is contained entirely within the City of Wilmington's corporate boundaries. The City of Wilmington Water Department provides the potable water supply. The city utilizes surface water from Brandywine Creek for its primary water supply.

The City's closest intake is on the Brandywine Creek at a dam in Brandywine Park, 2.5 miles upstream from the confluence of the Brandywine Creek and Christina River. Water is drawn from the Brandywine Creek via a raceway with headwaters approximately 1.2 miles west-northwest of the school property. The city supplies water to approximately 140,000 individuals in the Wilmington metropolitan area and has water system interconnections with other area suppliers.

There are no known users of groundwater for potable purposes within the study area.

A more detailed description of the George Gray School site is presented in the main Brownfield Environmental Assessment II Report.

The exposure pathway considered in this report is the inadvertent ingestion of soil. The inadvertent ingestion of sediment and the ingestion of local groundwater were not considered due to the lack of current users and limited potential for development of local groundwater resources. No groundwater, surface water or sediment samples were collected during this study.

2.2 Receptors

2.2.1 Present Time Receptors

There are no known on-site residents. Approximately 25,000 people live in the residential areas within one-mile of the site. Present-time exposure scenarios include on-site workers and trespassing children and adults. The building is currently vacant but has been undergoing interior asbestos and lead paint abatement. Details for these exposure estimates and default values can be found in Appendix 1. The pathway and route evaluated consists of inadvertent soil ingestion. There is no known use of local groundwater in the project site as the area is served by a public water supply system.

The maximum values for analytes detected in site samples in the soil pathway were screened based upon Risk-Based Concentration Values (RBC) for residential and industrial soils (U.S. EPA, Region III, April 12, 1999) and were also screened against one-tenth of the RBC to account for additive effects.

For inorganic and organic analytes detected, the highest concentrations of the analytes found in shallow soil samples (0 to 2 feet) and deep samples (greater than 2 feet) were used for the evaluation. Both shallow and deep samples were used to account for future excavation of soil during construction and renovation. Since no one sample contained the highest concentration of all analytes, this will result in a conservative, worst case scenario. It should be noted that the modeled risks and potential adverse health effects may not be characteristic of the entire study area.

2.2.2 Future Receptors

The study area for the George Gray School Brownfields Preliminary Assessment II is proposed to be renovated into a Work Force Development Training and Employment Center. It would include a culinary arts school and catering business, banquet and conference center, automotive training and repair facility, a telemarketing center and a computer center. Border properties are residential and parkland. For this reason, modeling for future land use will include the inadvertent ingestion of soil by residential adults and children, assuming no remediation, in addition to the present worker and trespasser scenarios.

3.0 Organic Contamination

3.1 Soil

Approximately thirty (30) shallow test pit and surface soil samples were collected from the study area during this assessment. The samples were field screened in the DNREC Superfund mobile laboratory for indicator compounds. Following screening, approximately twelve (12) test pit and surface soil samples were selected for all or part of the US EPA Target Analyte List and Target Compound List (TAL/TCL) analysis at an approved laboratory. A complete list of samples, sample locations and analytical results is contained in the main report.

The validated results of the organic analysis of the soil samples were screened via the Risk-Based Concentration (RBC) tables for residential and industrial soils (U.S. EPA, Region III, April 12, 1999).

The highest concentrations of organic and inorganic contaminants detected in soil samples from the George Gray School which exceeded the benchmark Risk-Based Concentration for residential and/or industrial soil are shown in Tables 1 and 2. The complete analytical results are shown in the main report.

3.1.1 Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(k)fluoranthene

Benzo (a) pyrene (BaP) and the others are polycyclic aromatic hydrocarbon (PAH) compounds. They are formed during the burning of petroleum products and plant or animal materials. It is also found in coal tar, road and roofing tars and in creosote. Cigarette smoke also contains PAHs. PAHs can enter the body by breathing smoke containing the material or by ingesting it. It is not normally absorbed through the skin, but small amounts may be if the skin has contact with heavy oils containing PAHs.

PAHs have been shown to cause tumors in laboratory animals and are suspected human carcinogens.

3.2 Risks for Present/Future Time Exposures Based on Soil Data

As modeled, BaP in soil sample TP-3S at 11.0 mg/Kg contributed the majority of the increased incremental lifetime cancer risk resulting from organic compounds for the theoretical future adult resident and present on-site worker. The RBC screening value for BaP in soil is 0.088 mg/Kg (residential) and 0.78 mg/Kg (industrial). This sample was collected from beneath the asphalt parking lot.

Table 1 shows an increased incremental lifetime cancer risk to the future adult resident at this site of 1.2E-04 due to BaP. The increased risk for the on-site worker as modeled was 2.8E-05 for BaP. Individually, the risk modeled for BaP exceeds the 1.0E-04 to 1.0E-06 acceptable cancer risk normally applied by U.S. EPA, Region III for the future adult resident scenario.

The additional cancer risks to the present and future resident and workers resulting from the presence of DahA, BaA, BbF, and IP all exceed the 1.0E-06 target risk when modeled individually, as shown in Table 1. BkF adds slightly to the increased incremental cancer risk for modeled receptors (Table 1).

3.3 Sediment

No sediment samples were collected during this investigation. There is no direct surface water or sediment pathway at this site.

4.0 Inorganic Contamination

4.1 Soil

The results of the inorganic analysis of the soil samples were screened via the Risk-Based Concentration for both residential and industrial (U.S. EPA, Region III, April 12, 1999). Only qualified data as per Appendix 2 were utilized.

The inorganic analytes that exceeded the Risk Based Concentration (for residential and/or industrial soil) benchmarks were Iron and Arsenic (as a carcinogen and non-carcinogen).

One (1) shallow sample and five (5) deep soil samples were submitted to the lab for inorganic analysis based on field screening. The sample locations and analytical results are presented in the main report.

Two (2) out of the six (6) samples analyzed for Lead during the study contained Lead at levels exceeding the Delaware Uniform Risk-Based Remediation Standard of 1000 mg/Kg for restricted use soils and three (3) others exceeded the unrestricted use level of 400 mg/Kg. No reference dose exists for Lead and it is discussed below. The highest concentrations of Lead in

soil detected during this study were 1510 mg/Kg in shallow test pit soil sample TP-4S and 1450 mg/Kg in TP-15.

4.2 Risks for Present/Future Time Exposures Based on Soil Data

Increased incremental cancer risk was modeled for Arsenic as a carcinogen for the theoretical future residents and present on-site workers. Utilizing the Arsenic level found in sample TP-16D at a concentration of 40.8 mg/Kg, Table 1 shows an increased cancer risk for the future adult resident of $9.6\text{E-}05$. For the on-site worker the increased incremental lifetime cancer risk was modeled at $2.1\text{E-}05$ for Arsenic. Arsenic in both the future resident and on-site worker scenarios falls within the normally accepted risk range of $1.0\text{E-}04$ to $1.0\text{E-}06$. The total modeled risk via soil exposure to organic and inorganic compounds combined as modeled for the future residents was $3.0\text{E-}04$ and for the present on-site worker was $6.7\text{E-}05$. The modeled residential risk exceeded the $1.0\text{E-}04$ to $1.0\text{E-}06$ normally accepted range (Table 1). As previously discussed, the presence of BaP, a PAH, in the surface soils was the primary factor in increased risk at the site.

4.3 Present/Future Time Potential Adverse Effects

The present-time adverse health effects were modeled for inadvertent ingestion of soil and are shown in Table 2. The potential adverse health effects as modeled resulted from the presence of Iron and Arsenic in deep soil at the site. Both Iron and Arsenic had HQs greater than 1.0 in the theoretical future child resident scenario (3.44 and 1.73, respectively).

When additive effects of Manganese, Chromium (as VI), Aluminum and Copper were included, the resulting Hazard Indexes were 0.47 for the on-site worker, 0.14 for the trespassing adult and 1.37 for the trespassing child. (Table 2).

For the theoretical future adult and child residing at the site, the cumulative HIs were 0.66 for the adult and 6.16 for the child, both exceeding the target of 1.0. (Table 2).

Some information on some of the major contributors to the Hazard Index or other potential adverse health effects is included below.

4.3.1 Arsenic

Arsenic is found naturally in the earth's crust. It is also a by-product of smelting of metals and burning of fossil fuels. The primary use of Arsenic is in weed and insect pesticides and as a wood preservative. It is also used in lead-base alloys for hardening lead used in batteries, bearings and cable and as a rust inhibitor in antifreeze.

Systemic effects of Arsenic ingestion include irritation of the digestive tract, decreased production of red and white blood cells, abnormal heart function, blood vessel damage, liver and kidney injury and impaired nerve function.

One of the most common characteristics of ingestion of inorganic Arsenic is the appearance of dark and light spots on the skin, or small corns or warts on the palms, soles and trunk. Arsenic ingestion has also been connected to increased incidence of some forms of cancer. In contrast, there is also some evidence that small amounts (normal dietary intake) of Arsenic may be beneficial to good health.

4.3.2 Iron

Iron is an essential element and therefore, any risk value must protect against deficiency as well as toxicity.

Acute Iron poisoning has been seen in small children who accidentally ingested iron supplements. Acute oral toxicity can affect the stomach and intestines, heart, liver and brain.

Several studies have noted a relationship between very high Iron intake and chronic Iron toxicity, and effects to the liver, heart and pancreas, including cirrhosis, cardiac dysfunction and diabetes.

4.3.3 Lead

Lead has been classified by the EPA as a Group B2 - Probable Human Carcinogen. While there is no reference dose or slope factor value for Lead, it is desirable to minimize Lead exposure to the extent possible, especially for children who preferentially absorb it. Children are also more sensitive to Lead anemia than adults, and young children may experience subtle neurological damage without ever exhibiting classical signs of juvenile lead brain damage, such as loss of motor skills and speech. Learning ability may be impaired due to motor incoordination, lack of sensory perception or inability to concentrate.

Usual Lead cleanup values that are commonly considered are the 400 mg/Kg residential level generally applied by the EPA as a trigger cleanup guideline. Lead in soils in residential neighborhoods above 400 mg/Kg merits further evaluation in future efforts; i.e., evaluation of blood-lead levels. The DNREC Uniform Risk-Based Remediation Standard for Lead is 1000 mg/Kg for restricted use and 400 mg/Kg for unrestricted use.

Using these guidelines, Lead may be considered of analyte of concern for future residents or others that may be exposed to site soils.

4.4 Groundwater

The development of local groundwater for drinking water purposes is highly unlikely due to hydrogeologic conditions and the presence of a public water supply. For this reason, no evaluation of the groundwater pathway was conducted.

4.5 Surface Water

No surface water samples from the Brandywine Creek were analyzed during this assessment.

5.0 Across Media Summaries of Cancer Risks and Adverse Health Effects

An across media summary was not evaluated as part of this Toxicological Evaluation. The soil pathway is the only pathway of concern for present time receptors. The future use of local groundwater in the vicinity of the study area is highly unlikely due to the presence of a public water supply and limited potential for groundwater development due to low yields and little available drawdown.

6.0 Recommendations and Summary

A large L-shaped building, a former elementary school currently occupies the study area. The site is mostly unfenced and trespassers have access to the property, especially the northern portion. The south parking lot contains numerous breaches in the fence.

Based on the modeled scenarios, parts of the study area may pose a present and future time exposure risk and exceedances of the target for increased incremental lifetime cancer risk for workers and future residents from organic and inorganic contaminants. The modeled risk results from inadvertent ingestion of surface soils containing PAHs and Arsenic. Some of the risks evaluated exceed the 1.0E-04 to 1.0E-06 acceptable cancer risk normally used by U.S. EPA, Region III, but most fall within the range on an individual basis.

The potential for adverse health effects for theoretical future resident children, as modeled, indicate that non-cancerous effects from inorganic analytes in the surface soil via inadvertent consumption at the site are a moderate concern based on analytical results.

Lead was present in two (2) out of the six (6) soil samples at levels exceeding the Delaware Uniform Risk-Based Remediation Standard of 1000 mg/Kg for restricted use soils and three (3) others exceeded the unrestricted use level of 400 mg/Kg. No reference dose exists for Lead. The highest concentration of Lead in soil detected during this study was 1510 mg/Kg.

The majority of the samples used in this evaluation were deep soil samples (greater than 2 feet) or collected from beneath an asphalt parking lot and therefore present minimal present time risk. For this reason, soils disturbed during excavation and construction will require proper handling.

It should be noted that the information contained in this evaluation is based on a limited number of samples collected across a relatively large area. In general, the highest concentration of organic and inorganic contaminants were used in the calculations as a very conservative, worst case scenario. The modeled risks should not be considered to be representative or characteristic of the entire study area or any individual property. Further evaluation, including additional sampling and analysis would be necessary to sufficiently define the potential risks.

7.0 Uncertainties Associated With Toxicity Assessment

In concluding this report, it should be noted that there are many uncertainties associated with the use of toxicological information in health risk assessments which are related to uncertainties intrinsic to toxicology, the models applied, and the interpretations of such derived results. Chief among these uncertainties are the use of dose-response information from high-dose studies to predict adverse health effects at low dose and also the applicability of experimental animal studies to predict effects in humans. However, these and other uncertainties are intrinsic limitations to the risk assessment process which cannot be resolved quantitatively given the current understanding of toxicology and human health. These uncertainties are addressed in part by consistent application of conservative assumptions regarding the toxic effects of chemicals, such as uncertainty factors for reference doses and upper bound estimates for cancer slope factors. Such procedures are intended to protect public health and are expected, in many cases, to overstate potential impacts on human health.

The summation of risks for analytes within and across media may also contribute to such worst case evaluation. Additional uncertainty, also not the case for this site, is usually incorporated by accepting the non-threshold theory for carcinogenicity, wherein any exposure to a carcinogen may result in a theoretical increased lifetime risk of cancer.

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FUTURE SITE USE SCENARIO - CARCINOGENIC RISK - SHALLOW AND DEEP SOIL									
Contaminant	Location	Concentration (mg/kg)	Exposure Factor	Resident Exposure Factor	Soil Concentration (mg/kg)	Soil Concentration (mg/kg)	Soil Concentration (mg/kg)	Soil Concentration (mg/kg)	Soil Concentration (mg/kg)
BENZO(a)PYRENE	TP-3s	11.0	NQ	1.2E-04	---	7.3E+00 (f)	---	---	B2
ARSENIC (as carc.)	TP-16d	40.8	NQ	9.6E-05	---	1.5 E+00 (f)	3.0 E-04 (f)	---	A
DIBENZ(a,h)ANTHRACENE	TP-3s	3.4	NQ	3.9E-05	---	7.3E+00 (e)	---	---	B2
BENZO(a)ANTHRACENE	TP-3s	14.0	NQ	1.6E-05	---	7.3E-01 (e)	---	---	B2
BENZO(b)FLUORANTHENE	TP-3s	14.0	NQ	1.6E-05	---	7.3E-01 (e)	---	---	B2
INDENO(1,2,3-cd)PYRENE	TP-3s	8.9	NQ	1.0E-05	---	7.3E-01 (e)	---	---	B2
BENZO(k)FLUORANTHENE	TP-3s	8.0	J	9.1E-07	---	7.3E-02(e)	---	---	B2
Total Increased Incremental Lifetime Cancer Risk				3.0E-04*					

PRESENT/FUTURE SITE USE SCENARIO - CARCINOGENIC RISK - SHALLOW AND DEEP SOIL									
Contaminant	Location	Concentration (mg/kg)	Exposure Factor	Resident Exposure Factor	Soil Concentration (mg/kg)	Soil Concentration (mg/kg)	Soil Concentration (mg/kg)	Soil Concentration (mg/kg)	Soil Concentration (mg/kg)
BENZO(a)PYRENE	TP-3s	11.0	NQ	2.8E-05	---	7.3E+00 (f)	---	---	B2
ARSENIC (as carc.)	TP-16d	40.8	NQ	2.1E-05	---	1.5 E+00 (f)	3.0 E-04 (f)	---	A
DIBENZ(a,h)ANTHRACENE	TP-3s	3.4	NQ	8.6E-06	---	7.3E+00 (e)	---	---	B2
BENZO(a)ANTHRACENE	TP-3s	14.0	NQ	3.5E-06	---	7.3E-01 (e)	---	---	B2
BENZO(b)FLUORANTHENE	TP-3s	14.0	NQ	3.5E-06	---	7.3E-01 (e)	---	---	B2
INDENO(1,2,3-cd)PYRENE	TP-3s	8.9	NQ	2.2E-06	---	7.3E-01 (e)	---	---	B2
BENZO(k)FLUORANTHENE	TP-3s	8.0	J	2.0E-07	---	7.3E-02(e)	---	---	B2
Total Increased Incremental Lifetime Cancer Risk				6.7E-05					

IRIS-2 (f), withdrawn from IRIS-2 (x), HEAST (h), HEAST alternative method (a), withdrawn from HEAST (y), EPA-ECAO (e), other EPA documents (o)
NQ, J, K, L, I = Data qualifiers applied -- see Appendix 2.
D = Diluted sample

*Rounded total from additional decimal places

** = By Inhalation only

Shaded areas = Exceedances of 1.0 x 10E-06 for Cancer Risk or 1 for Hazard Quotient.

NOTE: Dose-Response Modeling Paradigm -- see Appendix 6.

TABLE 2. QUALIFIED AND RISK-BASED CONCENTRATION-SCREENING YIELDING ANALYTES OF CONCERN EVALUATED TOXICOLOGICALLY AS NON-CARCINOGENIC EXPOSURE SCENARIOS FOR THE GEORGE GRAY SCHOOL SITE.

PRESENT/FUTURE SITE USE SCENARIO - HAZARD QUOTIENT - SHALLOW AND DEEP SOIL									
Chemical (analyte)	Location	Concentration (mg/kg)	Soil Exposure Factor (a)	Soil Exposure Factor (b)	Soil Exposure Factor (c)	Soil Exposure Factor (d)	Soil Exposure Factor (e)	Soil Exposure Factor (f)	Soil Exposure Factor (g)
IRON	TP-16d	80,800	NQ	0.7674	0.0822	3.0 E-01 (e)	---	---	---
ARSENIC	TP-16d	40.8	NQ	0.3875	0.0415	3.0 E-04 (i)	1.5 E+00 (i)	A	A
MANGANESE	TP-16d	735	NQ	0.1047	0.0112	2.0 E-02 (i)	---	D	D
CHROMIUM (as VI)	TP-16d	56.1	NQ	0.0532	0.0057	3.0 E-03 (i)	---	A**	A**
ALUMINUM	TP-9d	12,700	NQ	0.0361	0.0038	1.0 E+00 (e)	---	---	---
COPPER	TP-16d	343	NQ	0.0244	0.0026	4.0 E-02 (h)	---	D	D
Total Non-Cancer/Systemic Hazard Index for Shallow/Deep Soil				1.3735*	0.1471*				

PRESENT/FUTURE SITE USE SCENARIO - HAZARD QUOTIENT - SHALLOW AND DEEP SOIL									
Chemical (analyte)	Location	Concentration (mg/kg)	Soil Exposure Factor (a)	Soil Exposure Factor (b)	Soil Exposure Factor (c)	Soil Exposure Factor (d)	Soil Exposure Factor (e)	Soil Exposure Factor (f)	Soil Exposure Factor (g)
IRON	TP-16d	80,800	NQ	0.2635	3.0 E-01 (e)	---	---	---	---
ARSENIC	TP-16d	40.8	NQ	0.1330	3.0 E-04 (i)	1.5 E+00 (i)	A	A	A
MANGANESE	TP-16d	735	NQ	0.0359	2.0 E-02 (i)	---	D	D	D
CHROMIUM (as VI)	TP-16d	56.1	NQ	0.0182	3.0 E-03 (i)	---	A**	A**	A**
ALUMINUM	TP-9d	12,700	NQ	0.0124	1.0 E+00 (e)	---	---	---	---
COPPER	TP-16d	343	NQ	0.0083	4.0 E-02 (h)	---	D	D	D
Total Non-Cancer/Systemic Hazard Index for Shallow/Deep Soil				0.4716*					

IRIS-2 (i) withdrawn from IRIS-2 (x); HEAST (h); HEAST alternative method (a); withdrawn from HEAST (y); EPA-ECAO (e); other EPA documents (o).

NQ, J, K, L, [] = Data qualifiers applied - see Appendix 2.

D = Diluted Sample

* Rounded total from additional decimal places

** By inhalation only

Shaded areas = Exceedances of 1.0 x 10E-06 for Cancer Risk or 1 for Hazard Quotient.

NOTE: Dose-Response Modeling Paradigm - See Appendix 6.

TABLE 2. QUALIFIED AND RISK-BASED CONCENTRATION-SCREENING YIELDING ANALYTES OF CONCERN EVALUATED TOXICOLOGICALLY AS NON-CARCINOGENIC EXPOSURE SCENARIOS FOR THE GEORGE GRAY SCHOOL SITE.

FUTURE SITE USE SCENARIO - HAZARD QUOTIENT - SHALLOW AND DEEP SOIL							
Organic Analyte	Exposure Scenario	Concentration (mg/kg)	Unit	Resident Exposure (mg/kg)	Exposure Scenario	Exposure Scenario	Result
IRON	TP-16d	80,800	NQ	0.3689	3.4435	3.0 E-01 (e)	---
ARSENIC	TP-16d	40.8	NQ	0.1863	1.7388	3.0 E-04 (f)	1.5 E+00 (i)
MANGANESE	TP-16d	735	NQ	0.0503	0.4698	2.0 E-02 (f)	---
CHROMIUM (as VI)	TP-16d	56.1	NQ	0.0256	0.2390	3.0 E-03 (f)	---
ALUMINUM	TP-9d	12,700	NQ	0.0173	0.1623	1.0 E+00 (e)	---
COPPER	TP-16d	343	NQ	0.0117	0.1096	4.0 E-02 (h)	---
Total Non-Cancer/Systemic Hazard Index for Shallow/Deep Soil				0.6603*	6.1633**		D

IRIS-2 (f), withdrawn from IRIS-2 (x), HEAST (h), HEAST alternative method (a), withdrawn from HEAST (y), EPA-ECAO (e), other EPA documents (o).

NQ, J, K, L, I] = Data qualifiers applied - see Appendix 2.

* = Rounded total from additional decimal places

** = By inhalation only

Shaded areas = Exceedances of 1.0×10^{-6} for Cancer Risk or 1 for Hazard Quotient
NOTE: Dose-Response Modeling Paradigm - see Appendix 6.

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APPENDIX 1. TOXICOLOGICAL EXPOSURE ASSUMPTION, DEFINITIONS, AND EXPOSURE PARAMETERS APPLIED IN THIS RISK EVALUATION

Reasonable Maximum Exposure	Upper-bound, conservative, maximum exposure, based on the potential for all potential exposure routes and the potential for all potential exposure routes
Target Cancer Risk	1.00×10^{-6} (specific contaminant)
Target Hazard Index/Quotient Value	1.0 (unit-specific contaminant)
Acceptable Risk Range (U.S. EPA, Region III)	1.00×10^{-4} to 1.00×10^{-6}
Body Weight	Adult: 70 Kg Child: 15 Kg
Averaging Time (Years of Life)	70 Years
Drinking Water Ingestion Rate	Adult: 2 L/day Child: 1 L/day Age Adjusted: 1.09 (L-y/Kg-d)
Soil Ingestion	Adult: 100 mg/day (conservative) Child: 200 mg/day Worker: 100 mg/day (very conservative) Age Adjusted: 114.29 (mg-y/Kg-d)
Exposure Frequency	Residential: 350 days/year Occupational: 250 days/year
Exposure Duration	Residential: 30 years Occupational: 25 years
Child Trespasser	Two episodes per week for 39 weeks over six years
Adult Trespasser	May vary, but is generally two episodes per week for 30 weeks over 24 years

RELEVANT COMMENTS/NOTES/BENCHMARKS & SCREENING

The upper-bound estimate of carcinogenic risk is expressed in terms of the number of excess cancers over a lifetime in an exposed population under a specific exposure scenario. For instance, a carcinogenic risk of 1.0×10^{-6} ($1.0 \times 10\text{E-}06$ or $1.0\text{E-}06$) is defined as 1 additional cancer per 1 million exposed individuals. In general, the U.S. EPA (Region III, Technical Section and others) defines incremental carcinogenic risk within the $1.0\text{E-}06$ to $1.0\text{E-}04$ range being acceptable, with $1.0\text{E-}06$ being the point-of -departure. This supports a cleanup initiation point of $1.0\text{E-}04$. The target risk of *de minimis* risk level is considered also to be $1.0\text{E-}06$.

A non-carcinogenic threat is expressed in terms of a Hazard Quotient (HQ). An HQ is the ratio between the dose of a single substance over a specified period of time compared to the RfD for that substance. The Hazard Index (HI) is the sum of more than one HQ for multiple substances

or multiple exposure routes and pathways. When the HQ or the HI exceeds unity, there may be concern for potential non-cancer health effects. The target non-cancer risk here is unity.

Systemic effects, usually non-carcinogenic, requires absorption and distribution of the toxicant to a site distant from the point of entry, and at which point effects are produced. Most chemicals that produce systemic toxicity usually do not cause a similar degree of toxicity in all organs. Normally the major toxicity is demonstrated in one or more organs. These are referred to as the target organs for that chemical.

The combined carcinogenic risks and non-carcinogenic threats over a 30 year residential exposure duration (6 years as a child resident plus 24 years as an adult resident) are presented. It is recognized that a recently applied philosophical change is now being applied by Region III to estimate exposures to carcinogens and is used to derive the benchmark values. Previous versions of the benchmark table noted estimated exposures to carcinogens on the basis of 30 years of adult exposure. Now the calculations for three media have been changed to reflect 30 years of combined childhood and adult exposure, using **age adjusted factors** via integrated weight and ingestion/inhalation estimates for combined child/adult exposures. This has lowered the appropriate risk based concentrations for carcinogens in tap water, in ambient air, and in occupational and residential soil slightly. Other exposure rates such as for fish consumption remained the same.

The study herein does not apply the ingestion adjusted estimated exposure for carcinogens, and thus the modeled values for adults exposed to carcinogens in drinking water and soil ingestion or air will show slightly less risk. In time, as it is evident that the use of this age-adjustment factor has been followed without revision/change for a reasonable period of time, then our models will begin applying it routinely, but until a consistent pattern emerges, the past model parameters will continue to be used. The previous revision based upon body weight changes lasted for three months and wasted considerable time and effort related to revising the models. The most recently released and "corrected" benchmark values are used for screen purposes, thus analytes of concern are included based on the new philosophy and corrected tables.

Benchmark values are concentrations in various media providing cancer risks reported at 1.0E-06 or a HQ, non-cancer risk reported at unity or 1. These values have been generally applied as a screening level to identify analyte exceedances in this report so that such compounds may be considered for inclusion in risk assessment models. Risk-Based concentration Tables are provided via U.S. EPA Region III by Senior Toxicologist, Roy L. Smith, Ph.D., in the Technical Support Section (3HW13) on a quarterly basis and as noted in the references in this document. It is important to note that the accompanying comments relevant to the table provides the following information, comments and disclaimers.

"The table contains reference doses and carcinogenic potency slopes (obtained from IRIS through..., HEAST through..., OHEA-Cincinnati, and other EPA sources) for nearly 600 chemicals. These toxicity constants have been combined with 'standard' exposure scenarios to calculate chemical concentrations corresponding to a fixed level of risk (i.e., a hazard quotient of 1, or lifetime

cancer risk of $10E-06$, whichever occurs at a lower concentration) in water, air, fish tissue, and soil.

The Region III toxicologists use this table as a risk-based screen for Superfund sites, and as a desk reference for emergencies and other requests for immediate information. The table also provides a useful benchmark for evaluating preliminary site investigation data and contractor-prepared preliminary remediation goals. The table has no official status as either regulation or guidance, and should be used only as a predictor of generic single-contaminant health risk estimates. The table is specifically not intended as (1) a stand-alone decision-making tool, (2) a substitute for EPA guidance for preparing baseline risk assessments, (3) a source of site-specific cleanup levels, or (4) a rule to determine if a waste is hazardous under RCRA. In general, chemical concentration above the levels in the table suggest a need for a closer look by a toxicologist, but should not be used as the sole basis for taking any action.

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APPENDIX 2. GLOSSARY OF DATA QUALIFIERS APPLIED TO RESULTS OF LABORATORY ANALYSES*

Identification Codes (Confidence concerning presence or absence of analytes.)

	Not detected at the detection limit number and/or at appropriate sample concentration level. May be detected.
NQ	No Qualifier - Identification confirmed
J	Not detected substantially above the level reported on laboratory or field blanks.
R	Unreliable result. Analyte may or may not be present in the sample. Supporting data necessary to confirm result.
	Tentative identification. Consider present. Special methods may be needed to confirm its presence or absence in future sampling efforts.

Quantitation Codes (Can be used for both positive results and sample quantitation limits.)

J	Analyte present. Reported value may not be accurate or precise.
K	Analyte present. Reported value may be biased high. Actual value is expected to be lower.
L	Analyte present. Reported value may be biased low. Actual value is expected to be higher.
[]	Analyte present. As values approach the Instrument Detection Limit (IDL) the quantitation may not be accurate. (Above R but lower than J.)
UL	Not detected, quantitation may be inaccurate or imprecise.
UL	Not detected., quantitation limit is probably higher.

Other Codes

Q	No analytical result.
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* Codes normally utilized in risk assessment include: NQ, J, K, and L. Values in brackets are normally not used, but could be applied if judged appropriate. Brackets are considered higher in confidence than R but lower than J.

**APPENDIX 3. DATA SELECTION PROCEDURES APPLIED FOR
DEVELOPMENT OF CHEMICAL OF CONCERN**

For inclusion, data:

- A. Had no delimiting qualifiers, or were J, K, L or □ qualified.
 - B. Was the highest concentration encountered for specific medium.
 - C. Were analytes of concern with completed exposure pathways and exceedances of toxicological benchmarks, but not generally within an order of magnitude of such benchmarks unless specified. The latter is often discussed but not included in the calculations.
 - D. Had surface soil exposures for present and future risks which were given preference over subsurface sample data. Deep soil exposures discussed but not developed into scenarios.
 - E. Had filtered groundwater samples that were applied over non-filtered but unfiltered data usually is discussed.
 - F. Had results showing inconsistencies, differences between duplicates, high or low background levels, et cetera. Such results were noted and discussed but normally excluded from consideration in the exposure scenarios.
-

**APPENDIX 4. MAXIMUM CONTAMINANT LEVELS, MAXIMUM
CONTAMINANT LEVEL GOALS, AND SECONDARY
MAXIMUM CONTAMINANT LEVELS**

Maximum Contaminant Level Goal (MCLG)

An MCLG is a non-enforceable analyte concentration of a drinking water contaminant set at a level that will result in no known or anticipated adverse health effects and allows an adequate margin of safety.

Maximum Contaminant Level (MCL)

An MCL is an enforceable standard as a drinking water regulation set by the U.S. EPA under the Safe Drinking Water Act and adopted by the State. The standard relates to drinking water delivered to any user of a public system. It is a value as close to the MCLG as feasible with treatment technologies and costs considered. The MCL is protective of adverse human health effects. It may or may not pose a risk greater than $1.0E-06$. For certain analytes, especially those having long-time-established MCLs, it has been found at times to be the case whereby, for a specific chemical, the MCL may show an increased incremental lifetime cancer risk greater than the target value.

Secondary Maximum Contaminant Level (SMCL)

An SMCL is non-regulatory health guidance value which relates to the aesthetic quality of drinking water. Contributing factors include taste, odor, color, hardness.....

Reference Dose (RfD)

An estimate of a daily exposure to the human population that is likely to be without appreciable risk of deleterious effects over a lifetime.

Drinking Water Equivalent Level (DWEL)

A lifetime exposure concentration of adverse, non-cancer health effects, that assumes all of the exposure to a contaminant is from a drinking water source.

APPENDIX 5. EPA WEIGHT-OF-EVIDENCE CLASSIFICATION SYSTEM FOR POTENTIAL CARCINOGENS

Category	Group Description	Evidence of Support
Group A*	Human Carcinogen	Sufficient evidence from epidemiological studies to support a casual association between exposure and cancer in humans.
Group B1*	Probable Human Carcinogen	Limited evidence in humans from epidemiological studies
Group B2*	Possible Human Carcinogen	Sufficient evidence in animals, inadequate evidence in humans.
Group C	Possible Human Carcinogen	Limited evidence in animals and/or carcinogenic properties in short-term studies.
Group D	Not Classified	Inadequate evidence in animals.
Group E	Not Classified	No evidence in at least two adequate animal tests or in both epidemiological and animal studies

* Cancer Slope Values usually available via EPA, Integrated Risk Information System.

Source: U.S. EPA, 1986.

**APPENDIX 6. DOSE EQUATIONS USED IN THIS RISK EVALUATION –
INGESTION**

Hazard Quotient (HQ)

$$CDI = \frac{(CW) (IR) (EF) (ED)}{(BW) (AT)}$$

$$\frac{CDI}{RfD} = HQ$$

Cancer Risk (CR)

$$CDI = \frac{(CW) (IR) (EF) (ED)}{(BW) (AT)}$$

$$CDI \times SF = CR \quad \text{or} \quad CR = 1 - e^{(-Dose \times SF)}$$

CW = Concentration, mg/L or mg/Kg

IR = Ingestion Rate, L/day or mg/day

EF = Exposure Frequency, days/year

ED = Exposure Duration, year

BW = Body Weight, Kg

AT = Averaging Time, 25,500 days, carcinogen, adult; 9,125 days, non-carcinogen, worker;
2,190 days, non-carcinogen, child (period over which exposure is averaged, days)

CDI = Chronic Daily Intake

RfD = Reference Dose (NOAEL/Safety Factor)

NOAEL = No Observed Adverse Effect Level

RfD to Water = DWEL,

$$\frac{RfD \times 70Kg}{2 \text{ L/day}} = DWEL$$

95% Confidence Level = The mean +/- 2 standard deviations

Lifetime Durations = 70 years

CF = Conversion Factor, for soil ingestion, 1×10^{-6} Kg/mg

FI = Fraction Ingested, from contaminated source, usually 100% = 1
